• Machine Tool Issue •

THE above drawing of two men in a musty room with a few crude tools, is symbolical of the early struggles for accuracy and design which prefaced our 20th Century Machine Age. Only through the persistent zeal of a small and little publicized group of inventors and mechanics has it been possible to produce the machine tools that have brought modern conveniences to the masses.

CONNECTICUT INDUSTRY

• MAY • 1935

Pioneers in Industrial Fuels

NOT OLD in years—only a decade—but in that short span two important commercial movements have been successfully pioneered by T. A. D. Jones & Co., Inc.

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INC.

CONNECTICUT INDUSTRY

May 1935

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L. M. BINGHAM, Editor

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YOUR OX MAY BE NEXT

At the request of the House Committee on Interstate and Foreign Commerce, Wendell L. Wilkie, president of the Commonwealth and Southern Corporation, has just recently submitted specific recommendations for legislation which should meet every genuine complaint of the New Deal against certain evil practices of public utility holding companies. If the Administration accepts his plan or something very closely akin to it, then other business corporations with a number of subsidiaries may be considered safe, for the time being at least, against government encroachment on their operating methods. By such action the Administration would likewise clearly indicate that it was purely interested in protecting investors and consumers rather than scheming to promote government ownership or control of all corporate business under the guise of administering "a spanking" to public utilities by confiscatory measures.

From developments since the receipt of Mr. Wilkie's suggestions there is every indication that the Administration still insists on the Wheeler-Rayburn bill, even though it will accept minor modifications. By its passage in any form, the confiscation of other corporate structures will be progressively easier.

The political issue in the public utility controversy is now clearly drawn, even though it was apparent to many after analysis of the bill. Unless industrial, other corporate officials and leaders of business organizations show enough indignation to stop the goring of the public utility ox, it may be useless to hold forth later against the goring of their own oxen one by one.

There is no time to lose, for the Wheeler-Rayburn bill hearings may close any day, and the bill is near the top on the President's "must" list.

E. KENT HUBBARD

FEDERAL AND STATE LEGISLATION

Federal

There are days when an interpreter is needed for Washington news while "breakfasting" with the metropolitan daily paper if mental indigestion is to be avoided. Not that either the morning or evening grist is any more profuse than usual, but rather is it more difficult to weave into any kind of pattern that makes sense. Many of those who have visited Washington in recent months report an atmosphere pregnant with impending "breaks," like an error in the last half of the ninth with all bases full. The way of the interpreter is indeed hard, and to play safe he must necessarily confine his discussions to one active area at a time.

N. R. A. Prediction as to what will happen on extension after June 16 is largely guess work until after hand picked poultry case (Schecter Poultry Corporation Case) has been decided after hearings scheduled to start May 2. One thing is certain, that opposition to NIRA extension has increased tremendously within the past sixty days to the point where it is becoming increasingly difficult to find a business man or a union leader who is anxious to see it continued. Labor (A. F. of L.) would in all probability accept extension of NIRA even on modified basis as long as minimum wages, maximum hours and 7 (a) remained. Business would probably be opposed under any set-up, due to their past disillusionment on the promise of price fixing benefits which finally turned out to be sops in disguise for putting on the code harness. It is safe to expect extension in some form or at least some legislative set-up avowedly to settle strikes but actually to bolster power of A. F. of L. It's a game of strategy with A. F. of L. playing up 30 hour week and Wagner Labor Disputes Bill in the hope of getting something favorable to labor.

Work Relief. Passed with plans being considered for spending of it by the President. Some plans fairly certain are: Study of marketing, distribution and production costs to be done by white collar workers, census of unemployment, survey of all lines of business, other white collar relief projects yet to be developed, doubling of C. C. C. enlistments, grade crossing elimination, subsistence homesteads and slum clearance.

30 Hour Bill. Chances of final passage apparently very doubtful. Now on Senate Calendar.

Rayburn Utilities Bill. Hearings completed in House; started April 19 in Senate. Passage in modified form seems reasonably certain.

Wagner Labor Disputes Bill. Hearings completed in both Houses with Senate Committee now working on revised redraft.

Social Security. Passed by House April 19 with few changes. Senate committee has completed hearings but no executive action has yet been taken. Enactment of some type of bill likely in June.

Bank Bill. House Banking Committee voted report practically as introduced. Senator Glass leads strong opposition against it in Senate in its present form with Eccles provision for centralized control of credit.

Bonus. For political reasons bonus bill may have chance of passage under new plan of exchanging certificates for negotiable bonds.

Food and Drug Bill. On doubtful list but with good chances in Senate.

New Taxes. Nothing planned thus far except extension of excise or nuisance taxes.

Although other controversial measures will likely be considered before the close of the session, there appears to be little possibility of passing any controversial ones except those previously mentioned.

State

Committees of the General Assembly have been working against time to complete hearings and committee action on nearly 800 bills or 172 more than were unreported at the same time in 1933.

Old Age Pensions. Passed both Houses allowing $7 per week pensions to indigent citizens 65 or over who have no relatives legally liable and able to support them. Passage came after numerous amendments were offered and killed. To raise the money the bill as passed by both the House and Senate lays a head tax of $3 on all persons in the state between 21 and 65 who are not receiving aid as public charges from the state or towns. It repeals the $2 personal tax and makes the towns responsible for the collection of the new tax and payment of a $2,100,000 annual sum to the state. Administration is placed in the hands of the State Department of Agencies and Institutions.

State N. R. A. Bill reported out unfavorably by Judiciary after show of overwhelming opposition at hearings largely by manufacturers.

Textile Resolution. By formal resolution on April 16, the General Assembly condemned the cotton processing tax as "unsound and oppressive and detrimental to labor and industry," and requested Congress to terminate the levy, the North and South wage differential in the cotton textile industry and to restrict from any country to a volume not greater than the average annual importation from that country for the years 1930-1934.

Truck Regulation. Bill passed by both Houses largely as approved by Association which was one of its sponsors. (See C. I., Transportation Dept., April, for details.)

Other Motor Vehicles Bills. Slightly over 60% have been reported out, majority of which have been rejected. Bills on width and length of motor trucks which would affect manufacturers owning trucks have been opposed by Association at hearings but have not been reported out of committee.

(Continued on page 27)

MACHINE TOOLS

By L. M. BINGHAM

Spell the difference between taking the day off to go 25 miles by train to transact 15 minutes important business or do the errand in a two hour luncheon period . . . between the old time general store and the modern 5 & 10 . . . bare necessities for the middle class to the majority of modern conveniences and gadgets. England started their development; America has advanced them beyond fondest hopes of early builders; Connecticut has made a great contribution.

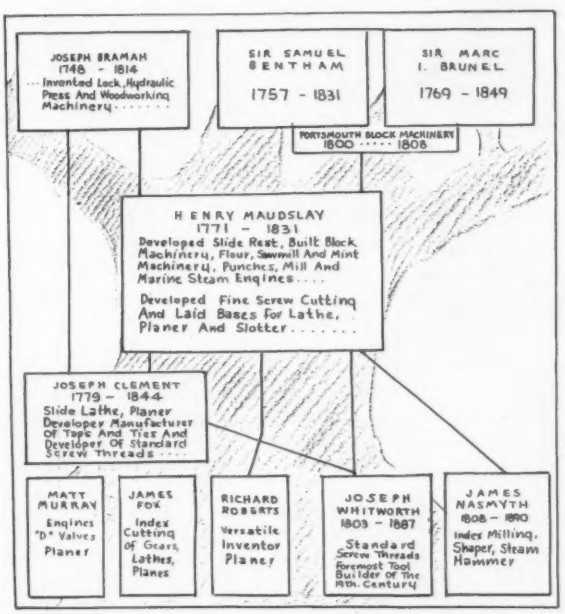
EDITOR'S NOTE: *In this story, only those Connecticut companies are discussed which manufacture a standard line of "machines that guide small tools in the cutting or chipping of metals," for that is the strict definition of Machine Tools. This definition serves to distinguish the makers of metal cutting and chipping machinery (Machine Tools—often referred to as machines that make machines that make consumer products) from the even greater number of builders of other special and standard machines used in the production of millions of capital and consumer goods items. Practically every company here classified in the Machine Tool group was originally a maker of special machinery (made-to-order) and many still produce it as well as other lines, such as small tools, gauges, jigs, fixtures and production machines. Producers of special or made-to-order machine tools or other machinery will be discussed in later articles.*

In the preparation of the first part of this article dealing with the general development and influence of the Early English and American builders, generous use is made of the facts contained in the excellent volume "English and American Tool Builders" by Joseph Wickham Roe and "Industrial Biography" by Samuel Smiles. The remainder of the story is built upon facts taken from local history, but principally from data furnished by executives of Connecticut's Machine Tool plants.

Because the stories of many of the larger companies would each run to article, and in some cases to book lengths, this historical presentation can merely explore the outstanding developments and trends. It is the thirteenth in a series of articles relating to the origin and development of Connecticut industries.

PHYSICALLY one of the weakest of nature's creations in the animal kingdom, man has become the most powerful through his ability to make and use Tools. Carlyle said, "Nowhere do you find him without Tools; without Tools he is nothing, with Tools he is all." In the light of these facts it appears strange, on the surface at least, that historians have directed their energies almost entirely to word painting of soldiers, statesmen, churchmen, authors, and a few inventors who struck the world's masses dumb with the "magic" of such inventions as the first crude steam engines, steamboats and telephones. But even a casual review of man's thinking habits for centuries, until quite recent years, demonstrates beyond doubt that our historians have been not only chronological "date slingers" and character portrayers but master salesmen, in giving the public what it wanted—life-like shadows of its own thinking. Through most of this period man looked upon war as the sole means to progress, as many of our visionary reformers of today view the onward "March of the Alphabets."

Against such a background of thought, it was inevitable that statesmen who arranged wars, soldiers who waged them, churchmen who blessed them, and authors who painted their glories, should have fallen heir to both headlines and text of current and historic writing instead of


JOSEPH BRAMAH
1748 - 1814
Invented Lock, Hydraulic Press And Woodworking Machinery
SIR SAMUEL BENTHAM
1757 - 1831
SIR MARC I. BRUNEL
1769 - 1849
PORTSMOUTH BLOCK MACHINERY
1800 ····· 1808
HENRY MAUDSLAY
1771 - 1831
Developed Slide Rest, Built Block Machinery, Flour, Sawmill And Mint Machinery, Punches, Mill And Marine Steam Engines....
Developed Fine Screw Cutting And Laid Bases For Lathe, Planer And Slotter.....
JOSEPH CLEMENT
1779 - 1844
Slide Lathe, Planer
Developer Manufacturer Of Taps And Tiles And Developer Of Standard Screw Threads....
MATT MURRAY
Engines "D" Valves
Planer
JAMES FOX
Index Cutting Of Gears, Lathes, Planes
RICHARD ROBERTS
Versatile Inventor
Planer
JOSEPH WHITWORTH
1803 - 1887
Standard Screw Threads
Foremost Tool Builder of The 19th. Century
JAMES NASMYTH
1808 - 1890
Index Milling, Shaper, Steam Hammer

FAMILY Tree of Outstanding Early English Tool Builders.

those secretive, self-effacing experimenters on mere tools that would aid in the pursuit of both peace and war.

The long void of nearly two centuries without any specialized, readily available knowledge of the lives of men who sought to fit hand tools to power, in the cutting of metals, only started to draw to a close within the past 25 years. The first known work, now out of print, describing the accomplishments of the early English Machine Tool Builders up to 1850, was "Industrial Biography" by Samuel Smiles. But not until Joseph Wickham

Roe, Assistant Professor of Machine Design at Sheffield Scientific School, Yale University, wrote his book on "English and American Tool Builders," were the important American developers of Machine Tools brought overalled and greased, from their dimly lighted workshops and set out with their accomplishments on the stage for public inspection. Then came the collection of business manuscripts by the George Baker Library at Harvard, which includes among thousands of stories of business practice and development much material on early tool builders. Still more recently, business and trade magazines

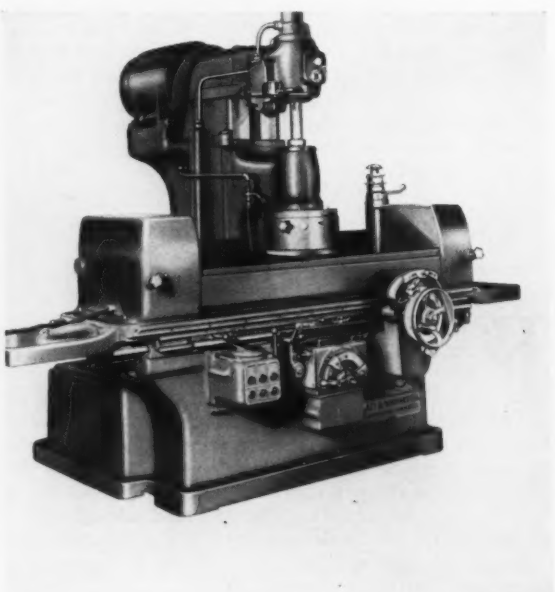
THIS 3 H. P. Rotary Engine built by Henry Hendey furnished the motive power used in the first workshop of the Hendey Machine Co., Torrington

and Sunday newspaper magazine sections have drawn upon both private and little used library history to portray, in popular vein, the frequently dramatic stories of inventors and developers of machines that have made products which have brought comfort and enjoyment to millions.

Although honest curiosity has in the past stimulated much research and written thought on the reasons for the painfully slow progress of man to the industrial age, for the sake of brevity they are summed up here in their most obvious forms as follows: lack of a unified banking system and a means for collecting small private hoards to provide sufficient capital for worth-while industrial undertakings; lack of adequate means for the development or transmission of power; and the lack of machine tools to work metals both accurately and economically. But without the modern development of machine tools the development of banking and the collection of capital by stock companies, would have been of no avail in the advancement of the industrial arts. Nor would it have been possible to complete the first modern motive power unit—the steam engine—without the aid of machine tools.

That the foregoing elements so necessary to industrial progress should have been supplied first in practical form by the English, seems a perfectly logical development. Being a fusion of the most virile tribes of the northern European continent and those of the British Isles, Englishmen fell naturally into the arts of navigation, colonization and trade. Once a far flung empire had been established a tremendous market for goods came into existence almost simultaneously. English shipping gathered raw products from its agricultural colonies, and exchanged them for teas, spices, trinkets, jewelry, homespun and other products from other countries and home markets. With the handsome profits made from these trading activities, there came into being in the latter part of the 18th century, the English banking system and the stock company, which in turn stimulated the desire for a manufacturing profit. Many men had had ideas of making machines to produce goods much faster than made by handicraft methods but none could make or find anyone who could build the tools which would enable them to form the necessary metal parts for their brain children.

This was the dilemma which faced Watt after he had labored years to complete the first successful small model of his steam engine. He tried in vain to find workmen and tools capable of boring a cylinder 6″ in diameter and 2 feet long, but finally had to be content with one painfully hammered out. Despite rags, cork, torn and old hats wrapped around the cylinder, there were still large spaces left which let air in and steam out. In short, Watt was never able to make his engine work satisfactorily until after John Wilkinson, of Bersham, England, developed in 1774 Smeaton's crude boring machine of 1769 vintage, one step further, by increasing the weight of the boring bar and extending it entirely through the cylinder to a fixed support. By 1776, Wilkinson, who was primarily a powerful factor in the iron industry of England rather than a tool builder, had bored a number of nearly perfect cylinders for Watt and his partner Boulton. Even those as large as 50″ in diameter were said to be in error less than "the thickness of an old shilling," which in the days prior to the introduction of limit gauges, was a common expression indicating fine work.



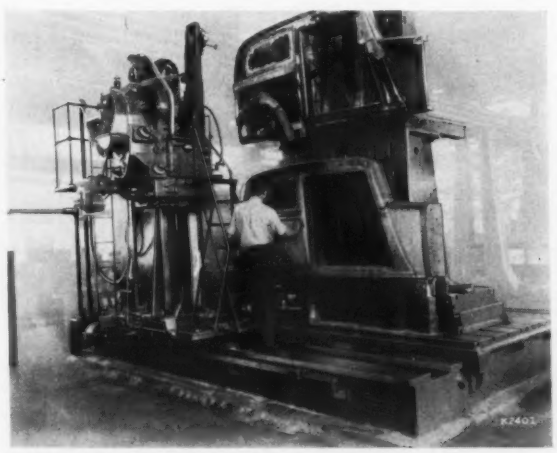
PRATT & WHITNEY 14-inch Hydraulic Vertical Surface Grinder.

The tools of 1775 were those which had been used for generations with the exception of a few crude lathes, drilling and boring machines, the principal members of which were wood. Many French designs of these antedated the English but had never been made practical. They were all practically useless for machining metal, except Wilkinson's boring machine, as they lacked the necessary power and a sufficiently strong holding device to guide the tools in cutting metal. The tools of the "millwright" were the hammer, the chisel and the saw, the measuring devices, a wooden rule, calipers and "an old shilling." Hand forging was probably as good as today. Foundry practice was equal to the needs of the day. But methods of cutting metal were little better than those of the middle ages and certainly not the equal of even the fascinating, but ill-proportioned drawings of machine tools made by Leonardo da Vinci in the 15th Century.

Invention of the slide-rest is now definitely credited to Henry Maudslay, of England, just prior to 1800, even though Joseph Bramah, Sir Samuel Bentham and Sir Marc I. Brunel, in England, and Sylvanus Brown and David Wilkinson, in America, are said to have invented it. Maudslay is given the credit for it largely because he first designed and built it along correct lines and developed its possibilities so that the modern slide rest is clearly seen as the lineal descendant of his. The outline of the work of the early English tool builders which follows is believed necessary as a basis of a true understanding of the American scene.

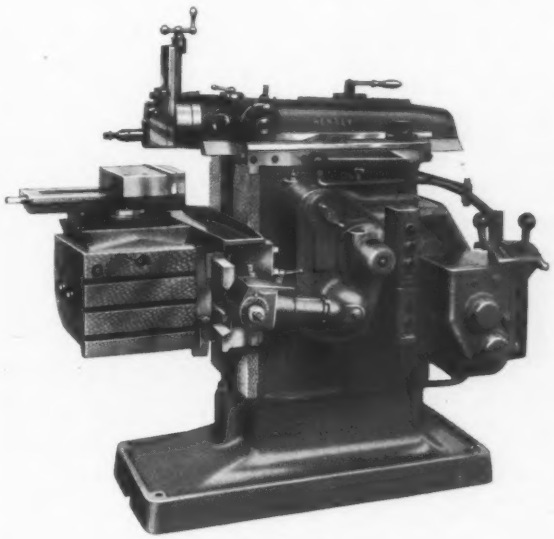
Early English Builders

Though John Wilkinson had built the first successful boring machine and therefore must be given rank as a tool builder, he was far outranked in influence as a tool builder by Joseph Bramah, a crippled farmer boy of Yorkshire, who became first a cabinet maker and inventor of the modern water closet in 1778, a lock in 1784 and later the hydraulic press, wood-working machinery, and other special purpose machines. Besides his personal influence on modern tools, which is difficult to judge, two men, Henry Maudslay and Joseph Clement, who left a marked influence on modern tools, were trained in Bramah's shop.



PRATT & WHITNEY'S Keller Automatic Tool Room Machine Cutting One-Piece Die for Side of Auto Body at Large Auto Body Building Plant.

The brilliant Maudslay, son of an old soldier, had little schooling and at the age of 12 was at work in the arsenal at Woolwich, and within a short time was regarded as the outstanding workman in the shop. In searching for someone to devise tools to produce his locks, Bramah was directed to Maudslay, then but 18 years of age. Although doubtful, at first, about the ability of so young a mechanic, Bramah hired him nevertheless (1789) and was amazed at his unusual ability by the end of his first day's work. Within a year Maudslay was made superintendent of the works, a position he held until 1797, when he resigned on being refused a raise in wages, to start his own small shop in London. It was during his employment at Bramah's workshop, however, that Maudslay developed the slide rest, other parts of the metal cutting lathe and made a start on the planer.



HENDEY Shaper

His career in business which ended only upon his death in 1831, was studded with greater all-round accomplishment than that of any of his contemporaries, and his influence in the field of engineering, particularly tool and marine engine design, has been unquestionably greater than that of any of the early tool builders. In addition to the slide rest, he designed and built punches, mill and marine steam engines, developed and modernized screw cutting, built screw cutting lathes, laid basis for modern lathe, planer and slotter, built 44 "Portsmouth Block Machines" for Bentham and Brunel, as well as sawmill and mint machinery.

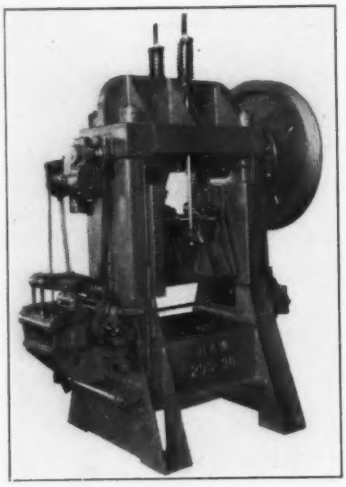
Even greater than his personal mechanical accomplishments was his great influence upon the men who worked for him, many of whom (Clement, Roberts, Whitworth, Nasmyth, Seaward, Muir and Lewis) left outstanding accomplishments in the field of machine tool design, while others spread the Maudslay methods and high standards to other shops in England. Successively, the name of Maudslay's firm was: Maudslay & Field and later, Maudslay, Sons & Field, which for many years was the leading tool building firm of the world, contributing most toward the standards which made it possible for England

to lead the world in tool building between 1800 and 1850, after which American machine tool builders forged ahead.

Preceding Maudslay in the genealogical table of tool builders were Sir Samuel Bentham and Sir Marc I. Brunel, originators of the famous "Portsmouth Block Machinery" which enabled 10 unskilled men to do the work of 110 skilled workmen in the making of ships' blocks. Bentham, a graduate of the Naval College at Portsmouth, was a designer and builder but excelled as an efficiency engineer. He had conceived the idea of the block machinery after being made inspector general—a reward for his suggestions to the Admiralty in the improvement of methods in the dockyards. These he had well along in the design stage when Brunel, a French naval officer who had become an American citizen, was introduced to him and permitted to show plans he had made for block machinery while in America. Bentham, showing his usual magnanimity, set aside his own plans and accepted Brunel's as being superior to his, commissioning him to build and install the machines. But Brunel, although a clever and original designer soon realized that he did not possess the mechanical ability to produce his own intricately designed machinery. On making inquiry for a competent mechanic he was directed to Maudslay, who had just started his own shop. Together these two men finished the job of supervising the construction and installation of the 44 block making machines set up at the Portsmouth dock yards, and thereby both gathered a reputation—Maudslay as a tool builder and Brunel as a designer.

To both Bentham and Brunel is due the credit for the design of the "Portsmouth Block Machinery," the former probably deserving the greater honor from the fact that he had set forth in his patent of 1793 the whole scheme of the woodworking machinery, which he was working out and would have completed successfully, had not Brunel suggested designs which Bentham considered improvements on his own. Bentham was truly the first great "efficiency engineer," as demonstrated by his installation of thoroughly efficient methods in the British navy and dockyards over a period of 18 years. His very efficiency made numerous enemies among the political makers of red tape, who were responsible for his forced retirement on a pension. But even his enemies came to consult with him in later years (1827 to 1831) on navy problems. Brunel, who later designed other woodworking tools and started a factory, became involved financially and was thrown into prison for debt. Finally freed through a grant of $25,000, secured from the government by friends, he spent the remainder of his life in civil engineering work, which finally brought him the Legion of Honor in 1829 and knighthood in 1841. Likewise to him goes the honor of being the father of Sir Isambard K. Brunel, later one of the foremost engineers of England, who built the first large iron ship ("Great Western") to make regular transatlantic crossings. He was also a great railway engineer.

Next to be considered in our early family of tool builders was Joseph Clement, son of a poor, uneducated weaver of Westmoreland, and himself having only slight knowledge of reading and writing. Starting life as a thatcher and slater of houses, he soon acquired the rudiments of mechanics at the village blacksmith shop. To repay the blacksmith for teaching him he made him a crude lathe, which was later used by him to make flutes and fifes for sale. He also made a microscope for his father to use in his nature studies. By 1804 he started work on screw-cutting, and about the same time made a set of die blocks without having any previous knowledge of their construction. He worked in numerous country shops



HENRY & WRIGHT Straight Sided Double Crank Tie Rod Steel Press with Automatic Double Roll Feed Scrap Cutter.

in and around the vicinity of Glasgow during which time he took drawing lessons from Peter Nicholson. So proficient did he become in the art of plan design that he was soon recognized as one of the most skilled draftsmen in England. From his earnings of $15 a week as a designer of power looms, at Aberdeen, he had saved about $500, which he took to London with him in the hope of starting in business for himself. Instead he went to work for a slovenly ward politician, Alexander Galloway, whose tools were in poor condition. On seeing Clement's remarkable ability at work in the conditioning of Galloway's tools, his shopmates advised him to secure a job at Bramah's shop where his work would be appreciated. Taking their advice, he went to work on a five year contract as Bramah's chief draftsman, where he did excellent work. On Bramah's sudden death, a year later, the contract was mutually terminated because of the jealousy of Bramah's sons over Clement's influence. Clement then became associated as chief draftsman at Maudslay and Field's where he did important work on designing the early marine engines.

In 1817 he started business for himself at Newington where he began the regular manufacture of taps and dies, using the standards developed by Maudslay as his basis. He introduced the tap with the small squared shank to drop through the threaded hole; made improvements over Maudslay's work on the screw cutting lathe, which made it a far more accurate tool; and made probably the greatest contributions to the development of modern planers. He built his first planer in 1820 to plane triangular bars of lathes and the sides of weaving looms, and a few years later built what was later known as his "great planer," a hand driven machine which would take in work 6 feet square. For over ten years this remarkable machine, with its bed which ran on rollers, mounted on

a concrete foundation, was never equalled in size by any other builder. It ran for several years on job work, day and night, machining approximately 22 square feet every 24 hours at a price of $4.32 per square foot.

As in the case of the lathe, the French were the real pioneers of the first crude planers, but their development up to the somewhere near modern design was brought about largely by English mechanics during the early 1800's up to 1840. Planers were also in use in the United States during this period, but it is generally conceded that the English development preceded them. Claim to the invention of the metal planer has been laid by such English mechanics as Spring of Aberdeen, James Fox, George Rennie, Joseph Clement, Matthew Murray and Richard Roberts. Because biography and autobiography is sadly lacking on the lives of many of these early mechanics, little light can be thrown on their work.

James Fox, founder of a well-known firm of machine tool builders, was originally a mechanically inclined English butler, whose employer furnished the money to start him in business after which he soon secured work from the firms of Arkwright and Strutt, founders of modern cotton manufacturing machinery. To do this work, Fox built a planer in 1814, which, with respect to the driving and reversing mechanism, was almost identical to Clement's great planer built about 10 years later. Although evidence regarding dates is uncertain, Fox is said to have invented a screw cutting machine, an automatic gear cutter and a self acting lathe.

George Rennie, son of John Rennie, one of James Watt's best-known workmen, succeeded with his brother, Sir John Rennie, to the ownership of his father's business. This business, John Rennie had started after the destruction of the Albion Flour Mills, where he worked and which had been originally constructed by him. It was during the successive development of this business that George Rennie was said to have built his planer.

Matthew Murray, born at Stockton in 1765, became an expert mechanic under the guidance of a blacksmith under whom he served his apprenticeship. Finding insufficient work around Stockton to furnish a livelihood for him and his wife (married before apprenticeship was completed) he found employment with John Marshall who was manufacturing flax machinery. For his excellent mechanical ideas he was paid an outright reward and soon advanced to first mechanic of the shop. Leaving Mr. Marshall at the end of 12 years he started with James Fenton and David Wood an engineering and machine building factory at Leeds in 1795. Here he started the construction of steam engines, became a strong competitor of Boulton & Watt, so much so, that the older firm bought the piece of property adjoining his factory to block his expansion. Besides making a planer which March (first employed by Murray in 1814), a well known tool manufacturer of the next generation, describes as being kept under cover because of not being patented, Murray improved the D-slide valve and simplified the steam engine. This planer, believed by March to be one of the earliest ones built, and other machine tools, were designed and built by Murray, first to aid him in producing flax machinery but later constructed for others. His many inventions and creative accomplishments contributed materially to the industrial supremacy of England prior to 1850.

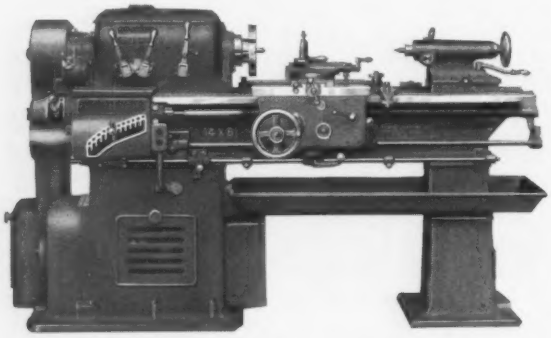
Richard Roberts, still another mentioned as an inventor of the planer, was born in Wales in 1789, and subsequently, like most of the early mechanics received little education. Starting his working life as a quarry laborer, he soon showed signs of mechanical ability, becoming well known among his fellow workmen through his dexterity in performing numerous mechanical odd jobs. Deciding to become a mechanic, he worked in a number of different shops and for a time was a pattern maker at John Wilkinson's Works, at Bersham. Then for a time he drifted about as a jack-of-all-trades from Birmingham to Liverpool and then Manchester and London—working as a pattern maker, turner, millwright or wheelwright. By 1817 he had ceased roving, settling down in Manchester, where he became (doubtless due to his roving bringing him into contact with the best practice of the day in mechanical lines) one of the most prolific and versatile inventors of all time. Within a short time he had built a planer which is undoubtedly the earliest planer still in existence (now in South Kensington Museum in London). It resembled, in a crude way, the modern planer. Other inventions for which he became noted were: the back-geared headstock having the cone pulley running loose upon the main spindle, and other improvements in the screw-cutting lathe; the first successful gas-meter; a number of drilling machines; the slotter and key-seater; punching and shearing machinery; the automatic spinning mule, one of the greatest textile inventions; other textile machinery and inventions of different types too numerous to mention here. Besides being an inventor he was responsible for laying the foundation of modern French cotton manufacture in 1826, and his firm—Sharp, Roberts and Company—built over 1500 steam locomotives establishing a reputation rivaling that of Stephenson & Co. of Newcastle. But despite his mechanical genius, he lacked business ability and died at London in poverty after having severed his connection with his company a few years previous.

Almost nothing of an authoritative nature can be mentioned here regarding the planer invention attributed to

GEOMETRIC Double Spindle Threading Machine (History of Geometric Tool Co., New Haven, in conclusion of this article, June issue).

Mr. Spring of Aberdeen. Joseph Clement's contribution to planer development has already been mentioned. This brings our summary of the early English tool builders down to the last two shown on the genealogy table—James Nasmyth and Joseph Whitworth.

James Nasmyth was the son of Alexander Nasmyth, a well known artist of Edinburgh whose ancestry of distinction dated back to the 13th century. Thus with respect to birth he had the lead on most of the early mechanics, the majority of whom came from poverty stricken families who could give them little or no education. Likewise, as a boy, he had the opportunity of playing in his father's well equipped work shop, and of learning to use all of the tools while still a schoolboy. During young manhood, he traveled with his father often, where he had the opportunity of meeting many distinguished engineers and of visiting many large plants, greatest of which was the Carron Iron Works. These contacts with great minds and large factory operations, as well as his regular Saturday afternoon visits to the small foundries and shops of the neighborhood, all made a profound impression upon Nasmyth and contributed probably more than any books he studied toward his education as an engineer. As a mere lad he made unusual tops and small hand cannon for sale, on his father's hand lathes. At the age of 17 while attending lectures at the Edinburgh School of Arts and the University he had become a skillful maker of models and also had built up a good business in engine models, cast over an improvised furnace in the grate of his room.



HENDEY 12 Speed Geared Head Motor Driven Engine Lathe.

At the age of 19, Nasmyth built a steam road carriage which he ran around the streets of Edinburgh for a time, but dismantled it when he found it was useless on the poor country roads. From his general inspection of steam engines from different makers, he came to the conclusion that Carmichaels of Dundee, Scotland, built a superior product, and that the reason therefor was due to the employment of improved mechanical tools and the most skilled mechanics. Discovering that many of these highly skilled workmen were imported from Maudslay's machine shop in London, Nasmyth developed a strong desire to become an apprentice under this great mechanic. So in 1829 he made personal application of Maudslay to become an apprentrice, but was told, in a friendly way, that gentlemen apprentices had never given satisfaction and that no more would be taken on. However, on noting Nasmyth's intelligent interest when shown about the shop, and after looking over his drawings, Maudslay offered him a position, not as an apprentice, but as his right hand man. He stayed on at the Maudslay Sons and Field plant until shortly after Maudslay's death and then left to start his own business in Edinburgh. But while at Maudslay's, he designed and built his index milling machine for finishing the sides of hexagon nuts, which is one of the outstanding inventions for which he is noted.

Beginning his own business in a small 18′ x 24′ outbuilding near his father's home, Nasmyth with his one mechanic and a power plant consisting of a laborer who turned a crank, built a lathe, a 20″ x 36″ planer and a few boring and drilling machines. These he moved to larger quarters in Manchester in the latter part of 1831 and carried on a successful machine tool business until retirement to his estate, in Kent, in 1856. For 16 years he had as a partner and business manager, Holbrook Gaskell.

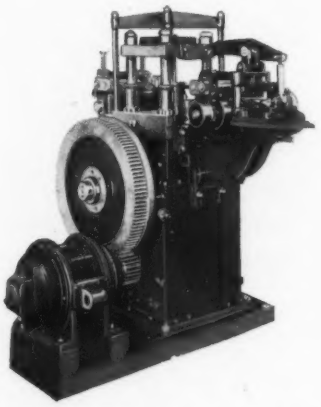
Of all the early machine tool builders Nasmyth and William Fairbairn are the only ones leaving records of their lives in the form of autobiographies. In Nasmyth's autobiography is also much information on the character and business practice of the great builder, Maudslay. Chief of Nasmyth's inventions were: a shaper in 1836; the index milling machine, about 1830; and the steam hammer. The latter he sketched out in plan form in his "Scheme Book" in 1839, with a view of building it to hammer out a 30″ paddle shaft for a large transatlantic liner, but changed specifications of the boat made it unnecessary to build the hammer. Three years later, Nasmyth found his hammer doing good service in France, which caused him to make haste to patent it both in England and in the United States. Besides manufacturing tools, Nasmyth also built a number of locomotives for the Great Western railroad, and invented numerous other smaller items of mechanical nature such as the flexible shaft made of a coiled spring, the ball and socket joint for shafting hangars and the single wedge gate valve. He also made several reflecting telescopes which he used in his astronomical studies of the moon to which he devoted much time after 1842, and which were recorded in an authoritative book, "The Moon, Considered as a Planet, a World and a Satellite," published in conjunction with James Carpenter in 1874.

Although numerous other early English and a few Continental mechanics influenced machine tool building (notably Sir Peter Fairbairn of Leeds, Charles Holzapfel, son of a German mechanic who settled in London and John George Bodmer, a Swiss millwright and inventor of a special machine, who worked in Baden, Austria, and England), space limits will not permit details other than mention of the last of our genealogical group—Sir Joseph Whitworth.

Son of a minister and schoolmaster of Stockport, he was placed at 14 in the office of his uncle, a cotton spinner of Derbyshire, to learn the business (1817). Indifferent to the commercial side of the business, he slighted his office duties to investigate every mechanical detail of all machines in the shop, and then ran away to Manchester where he went to work as a mechanic. Before starting his own shop in Manchester, in 1833, he was employed by Maudslay, and later by Holzapfel and Clement. His first stock-taking of machinery at the cotton mill and his subsequent work convinced him that all machinery was far from perfect and that it was up to him to improve it. He made marked improvements on the lathe, planer, drilling, slotting and shaping machines, adding

the quick return motion to Nasmyth's shaper. At the time of the London Exposition his tools were the standard of the world, their excellence being chiefly due to their standard of accuracy and quality rather than their novelty of design.

Whitworth's entire work was colored with his early conclusion that the two greatest elements in constructive mechanics which need the closest attention are "a true plane and power of measurement." He realized his first objective by making the best set of plane surfaces ever built up to his time, then proceeded to perfect a system of "end measurements," relying principally on the sense of touch rather than eyesight; and for extreme accuracy on the falling of a tumbler held by friction between two parallel planes. In a paper delivered by him in 1856 he points out that his measuring machine, which detected



HENRY & WRIGHT 25 Ton Dieing Machine equipped with Direct Motor Drive Scrap Cutters and Overhead Knockout.

differences in length up to one-millionth of an inch, would give all of the accuracy necessary or desirable. Thus the end measuring principle came into general commercial use except in extremely accurate work where line measurements are used with the aid of the microscope.

Although Maudslay and Clement had done much to improve thread practice, it was Whitworth who brought order out of chaos in the screw thread of England. Using the work of the former as a basis and by collecting and comparing all screws attainable, Whitworth finally arrived by 1841 at a thread contour and a pitch for all sizes of screw threads. The "Whitworth thread" became the standard for the country by 1860.

Nearly all memoirs of Whitworth refer to the profound effect of the report made by Whitworth and George Wallis of the South Kensington Museum, on their visit to the manufacturing plants of New England and the Middle States in 1853. The impression made upon Whitworth and other members of the British Commission brought about the remodeling of the gun making plant at Enfield using American tools and methods. The report indicated that Whitworth was particularly impressed with the extent to which the automatic principle was applied to machine tools in America.

Besides raising the art of machine tool building to the highest plane in England he became a world authority on heavy ordnance and a partner with Sir William Armstrong in one of the largest gun factories in the world. Without doubt Whitworth was the foremost tool builder in the world in 1850. The very ascendency of his methods which dominated English tool practice for several generations is believed by Professor Rowe to have been a contributing factor in the loss of England's leadership in tool building to America after 1850.

In a hasty glance backward to the early tool builders we have just discussed, it will be noted that all were men of powerful intellects even though the majority of them received little theoretical education. If we would draw an object lesson from their performance it may be set down that, "given a powerful mind, good health and the driving force of ambition, a man will make at least some worthy contributions to society despite the lack of formal education."

The Early American Scene

America was robbed of an early start in the field of power manufacture by the absolute prohibition by the British of metal manufacturing until the Revolution terminated British legislative control; by the subsequent lack of adequate machinery and skilled workmen, embargoed to America by the British; and the lack of adequately large consuming centers of population connected by adequate transport. But despite the British forbidding legislation, the Yankees, by stealthy handicraft methods, managed to make enough guns and ammunition to wage a successful revolution. And the British economic blunder of 1785, which forbade the exportation to America of English tools, engines or machines and even the emigration of skilled mechanics and workmen in iron and steel, while slowing up the development of American industry at the start, probably accelerated it in later years, because it stimulated a race of skillful mechanics.

To overcome this lack of efficient machinery and mechanics, commissioners were appointed under the terms of the first tariff act of 1789 and given authority to defray emigration expenses of artisans and manufacturers in certain lines and to offer rewards for inventions and improvements with a view of attracting skilled workmen who would improve the totally inadequate machinery of that day. What machinery there was prior to the Revolution was purely hand operated with the exception of a few trip hammers and a few small rolling mills and saw mills. Joseph Jenks who came from Hammersmith, England, was one of the earliest American mechanics. He started the iron foundry and forge at Lynn, Mass., with the backing of Governor Winthrop of Mass., about 1644. Later he made improvements in water wheels, invented a saw mill and a wire drawing machine, built for the town of Boston the first fire engine used in this country, and was also granted a Massachusetts patent for scythes, which were long and thin instead of short and thick, like the English scythes formerly used. A few other pre-Revolution founders and mechanics were other members of the Jenks family (active to this day in manufacturing); the Leonard family of English descent; Hugh Orr, a Scotchman who became the pioneer edge tool maker of the country after 1738, and arms manufacturer from 1748 until after the Revolution; Joseph Holmes of Rhode Island, maker of iron anchors and cannon; Daniel Waldo, iron maker who started the Hope Furnace at Scituate, R. I.; Ethan Allen, who set up a forge at the Ore Hill mine at Salisbury, Conn. in 1762; Stephen Goodyear, who set up a forge and iron mill in 1665 at the outlet of Lake

Saltonstall, near New Haven. The greater portion of the early establishments for the production and manufacture of iron prior to the Revolution and for some time after were located in R. I. and Mass. around Narragansett Bay.

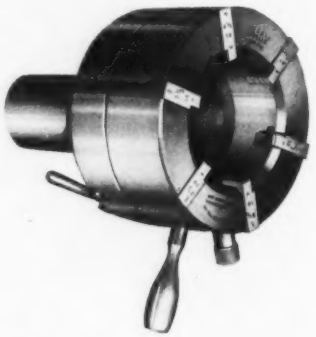
In the developments after the Revolution, one often finds the names of Wilkinson, Jenks, Brown, Greene of Revolutionary fame, Allen, Slater, Howe and Orr, most of whom were prominent in the early development of Pawtucket and Providence into important manufacturing centers. The Wilkinson family, starting with Oziel Wilkinson, a Quaker, who came to Pawtucket from Smithfield, R. I., in 1784, to start an anchor forge, was the most influential. Five of his six sons were successful manufacturers and his four daughters all married men who became successful manufacturers. Thus this family made a far greater contribution to the developments of early manufacturing in America than any other.

David Wlikinson built a steamboat in 1794 and invented a slide lathe in 1797; other Wilkinsons were identified with many of the early textile enterprises which was the first reason for the development of the general machine tool, then as a necessary aid to building textile machinery. Samuel Slater, an Englishman who had served his time with Arkwright & Strutt and had become familiar with the Arkwright machinery, had managed to run the English embargo by disguising himself as a rustic. Sailing from London, he went first to Philadelphia in 1789, but on later hearing of Moses Brown's attempts to start spinning operations at Providence, he wrote to him making arrangements to reproduce for him the Arkwright machinery at Pawtucket. Sylvanus Brown, previously mentioned as one of the contenders for the honor of being the first inventor of the slide rest, produced his planer or slide lathe presumably to aid in the construction of the Arkwright machinery which he helped Slater build. He is said to have invented it still earlier, in 1791, and used it for cutting wrought iron screws for sperm-oil presses, but there is no authoritative proof of it.

After the first of the Arkwright machinery had been painfully constructed by Slater and his assistants, he joined his efforts with his father-in-law Oziel Wilkinson and his brothers-in-law Greene and Wilkinson, in starting a second mill in Pawtucket. Slater continued to expand his activities and in 1822 started, in a little two story building in company with Larned Pitcher and three other men, what is known today as the great Amoskeag Mfg. Co., on the Merrimac River at Manchester, N. H. Known for many years as the greatest textile mill in the world, its early charter permitting practically any type of manufacture, the company operated for a considerable time as one of the largest machine shops in the country, where engines, locomotives, boilers, textile machinery, mill machinery and machine tools were built.

Pawtucket and Providence, where the early textile industry was cradled under the fathering of Slater and such strong entrepreneurs as the Wilkinsons, of necessity became the first manufacturing center for textile machinery which, in turn, forced the development of machine tools. In fact machine tools being merely the means to an end were side lines in all machine shops and armories until around 1850, when the demand brought about by the development of textiles, railroads, steamships and numerous other metal working industries, began to cause a number of companies then building tools, to concentrate their efforts in the machine tool field, and to spur the organization of many new companies.

Prior to this development, many mechanics migrated from Pawtucket to Lynn, Lawrence, Lowell and Manchester where they either started the manufacture of textiles or textile machinery or became associated with others who had discovered the value of the splendid water power furnished by the Merrimac River for manufacturing. Worcester and Fitchburg seem to have been the first towns in Mass. to develop successfully shops producing machine tools, the former for a number of years being the largest machine tool center of New England. From Pawtucket, too, some of the mechanics, notably one of the descendants of the Jenks family, of Lynn, Alfred Jenks, who had served his apprenticeship under Slater, went to Holmesburg, Pa., in 1810, to start the first factory in that state for producing textile machinery exclusively. He later moved to Philadelphia. Philadelphia, for many years the largest tool building center in the country received not only an impetus from Yankee mechanics in the building of textile machinery, but also from one



GEOMETRIC Style C Self-Opening Die Head.

Yankee who became one of the foremost machine tool builders of the country, Bement. Bement was the son of a Connecticut farmer, born in New Hampshire and trained at the Moore & Colby plant at Peterboro, N. H., and the Amoskeag Mfg. Co. machine shop, later receiving much valuable experience by doing special and contract work largely in New England shops before going to Philadelphia to become a partner in the firm of Marshall, Bement and Colby. This firm, although reorganized several times shared with William Sellers and Company the honor of contributing most to machine tool building in Philadelphia.

Until after 1870 all machine tool building worthy of the name was done east of the Allegheny mountains. The writer has traced in a sketchy way, the main lines of influence except those originating or developing in Connecticut, up until the westward movement to Cleveland, Indiana, Illinois, Wisconsin and Michigan began after 1870. The remainder of this article will deal with Connecticut as a tool building center, its influence on the establishment of other machine tool centers, and with the history of each of its present day companies who are considered producers of machine tools.

Connecticut's Early Developments

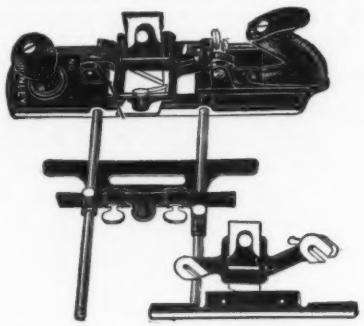
The rise of the interchangeable system of manufacture, first applied to gun making and later to bicycles, sewing machines, business machines, and a host of other machines

(Continued on page 20)

NEWS FORUM

Stanley Introduces New Cutter Attachments. The Stanley Rule and Level has recently introduced a Ship Lap Joint Attachment and a Circular Attachment for use by carpenters, decorators and building maintenance men now using the Stanley Fibre Board Cutter No. 193, a tool especially designed to slit, bevel, mitre, and groove fibre board.

The Ship Lap Joint Attachment illustrated below, makes it possible to produce well-insulated joints in fibre board, while the Circular Attachment furnishes the curved lines so necessary in the production of fancy design work and



arches. Also a Special Right-hand Grooving Cutter, which is easier to set and less liable to clog on certain materials, has also been added to this tool.

The Stanley Fibre Board Cutter is furnished complete with the two new attachments and two Grooving Cutter Holders (one for re-sharpening type cutters; the other for razor blade type cutters), plus the other guides and holders previously announced as No. 193A, at a price of $13.00. With only one Grooving Cutter Holder and without the two attachments as mentioned under the description of No. 193, the cutter is furnished at $10.00.

* * *

Weedon Returns to New England. Daniel R. Weedon, formerly an executive of the Russell Manufacturing Company in Middletown, Conn., who has been making his home in Ambler, Pa., became associated with the Sayles Finishing Plants, Inc., on April 1 as a vice-president, director and sales manager.

* * *

Electro-Platers Arrange Plant Visitation. The American Electro-Platers' Society which is staging its 1935 annual convention and exhibition at Bridgeport, June 10 to 13 inclusive, has just recently secured permission to escort its membership and guests through the American Tube and Stamping Plant of the Stanley Works and the Bridgeport Brass Company, both of Bridgeport. Visitors will have their choice as to which of these plants they wish to visit during the morning of the plant visitation.

The American Tube and Stamping Company plant, purchased by the Stanley Works, of New Britain, Conn., in 1926, is a sizeable and thoroughly modern steel plant furnishing both hot and cold rolled strip steel and billets to the trade, and hot rolled strips for its Howard Avenue Cold Rolling Mill at Bridgeport, and the Stanley Works Cold Rolling Plant at New Britain.

The Bridgeport Brass Company, one of the largest independent brass and copper mills in the United States, was established in 1865 by a group of men long experienced in the brass business. During this time it has pioneered many new products and methods, particularly being the first to introduce electric melting furnaces to replace the crucible fire method. One of the many of its noted products is seamless copper and brass tubing and pipe which it has produced for more than fifty years.

More than 50% of reservations already made have been contracted for by exhibitors of electro-plating equipment, and many of these exhibitors are planning to give working demonstrations.

Management of all eastern industries who wish to keep the key men of their organizations "up to the minute" in electro-plating processes and methods for the production of better work, should immediately make reservations for their men of Eugene Phillips, Chairman, Publicity Convention Committee, 67 Roanoke Avenue, Fairfield, Conn.

* * *

International Acquires American Silver Assets. Sale of part of the assets of the American Silver Company, of Bristol, Conn., to the International Silver Co., Meriden, for $75,000, has been recently approved by Judge Ernest A. Inglis of Hartford County Superior Court, upon petition of the Bristol Bank and Trust Company, as receiver for the Bristol concern. The assets sold include dies, tools, machinery, trade-marks and trade names. Land and buildings of the company, valued at $103,000, were not included in the sale. After sale of land and buildings and deduction of taxes owed to the City of Bristol amounting to $36,409.05, stockholders will receive the residue.

* * *

Worth Takes Option on Goodyear Mills. Joseph C. Worth, treasurer of the Uncas Finishing Co. of Mechan-

HADFIELD, ROTHWELL, SOULE & COATES

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HARTFORD-CONNECTICUT
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icsville, Conn., who has been using a part of the Goodyear (Conn.) Mills, owned by Powdrell Associates for storage purposes, has taken an option on the plant and real estate. The Goodyear mill village consists of a mill, a seven-story concrete stockhouse, a 50-room hotel and more than 200 tenements and many other buildings formerly used by the Goodyear Co. until the close of its operations some three years ago.

* * *

Veeder-Root Exhibit at Greenville, S. C. The Veeder-Root Co., Hartford Conn., featured a two-booth display called "Veeder-Root Parade" of counters, a step-by-step presentation of counting device developments during the last 56 years, at the Eleventh Southern Textile Exposition held during the week of April 7th at Greenville, S. C.

Graham H. Anthony, president, and John H. Chaplin, vice-president, in charge of sales, were present during the exposition. The booth was in charge of Edwin Howard, Southern Sales Manager.

* * *

Death of Frank D. Dorman. Frank D. Dorman, 76, treasurer and general manager of The Automatic Machine Co., Bridgeport, Conn., since 1925, died April 8th in his apartment in the Stratfield Hotel, after a long illness with heart trouble.

Born and educated in Cleveland, Ohio, practically all of his business life was spent in the mechanical field. In the early days of the automobile industry, he was the dominating spirit in the American Motor Carriage Company of Cleveland, and from 1905 to 1912 he was vice-president and general manager of the Maxwell-Briscoe Motor Company of Tarrytown, N. Y., where he was associated with W. C. Durant in the formation of the original Chevrolet Motor Company. He was vice-president of the United States Motor Company for a number of years prior to his coming to The Automatic Machine Company about 11 years ago.

He is survived by two brothers, a son and two grandsons. Burial was made in the family plot in Cleveland, Ohio.

* * *

Charter Oak to Adorn Tercentenary Stamp. The Post Office Department at Washington definitely decided on March 27 that the Charter Oak design would adorn the Connecticut three cent Tercentenary stamp instead of the map of Connecticut, when it went on sale in Hartford on April 26th. In the April issue of *Connecticut Industry*, it was reported that the Connecticut map design would be used and that the stamp would go on sale simultaneously at Hartford, Windsor and Wethersfield. Even plans of the Post Office Department change!

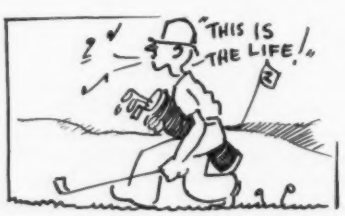
* * *

Trumbull Heads Manufacturers' Committee. Henry Trumbull, vice-presdent of the Trumbull Electric Company at Plainville, accepted during the last week of March, the chairmanship of the Committee on Exhibit of Inventions and Manufactures. Other members of the committee named to serve with Mr. Trumbull in arranging for local and state exhibitions of inventions, processes and products of Connecticut industry are: Carl H. Baldwin, vice-president of the American Hardware Company, New Britain; Dudley S. Ingraham, vice-president of E. Ingraham & Co., Bristol; Edwin Pugsley of the Winchester Repeating Arms Co., New Haven; F. C. Spencer, president of I. S. Spencer's Sons, Inc., Guilford; William R. Webster, chairman of the board of the Bridgeport Brass Co., Bridgeport; Roy C. Wilcox, secretary of International Silver Co., Meriden; S. H. Williams, president of J. B. Williams Co., Glastonbury; Charles L. Taylor, president of Taylor and Fenn, Hartford, and Clayton R. Burt, president of Pratt and Whitney Co., Hartford.

Edward H. Davis of the Scovill Manufacturing Co., Waterbury, is a special industrial associate for the committee, engaged in the work of organizing a state exhibit and acting as the liaison man between the committee and local committees in the various towns. The project is supported by the Manufacturers' Association of Connecticut through its president, E. Kent Hubbard, a member of the Tercentenary Commission and its vice-president, John H. Goss, also vice-president of the Scovill Manufacturing Company.

* * *

Spear Leaves American Hardware Company. George P. Spear, a leader in New Britain industrial and civic circles for many years, retired as general manager of the



Corbin Screw Corp., at a special meeting of the board of directors of the American Hardware Corporation held on March 20th. John S. Black was appointed general man-

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ager to succeed Mr. Spear and Ernest E. Baldwin was appointed sales manager.

Coming to New Britain in 1897 to become auditor at the office of North and Judd Company, Mr. Spear later in 1905 became associated with the Corbin Screw Corporation as office manager. On May 24, 1914, he was appointed assistant manager of the plant and later in 1920 he succeeded Charles Glover as general manager. He was vice-president and director of the American Hardware Corporation, a director of the New Britain National Bank and of the New Britain Gas Light Company, and a member of the city board of finance and taxation. On retiring, Mr. Spear stated he planned to take a long rest.

Mr. John S. Black, his successor, is a graduate of Alabama Polytechnic institute, and was prior to the world war, general manager of the Eureka Company in Northeast, Pa. He came to New Britain 14 years ago and became associated with the Corbin Screw Corporation where he has been general superintendent.

* * *

Sop for Depressed. Income tax returns paid by Connecticut residents during the first 20 days of March exceeded by 45% those paid in 1934, according to A. Don Bitgood, acting collector of internal revenue. Mr. Bitgood reported that at the close of business, March 20th, his office had collected $6,555,077.70 since March 1 while during a similar period in 1934 the collections amounted only to $4,513,310.21.

For the nation as a whole at the end of the first 15 days of March, collections showed an increase over 1934 of about 29 percent.

* * *

Electric Boat Starts New Submarine. The Electric Boat Company of Groton, Conn., laid the keel of the U. S. submarine Pickerel on March 25th. This was the second of the three keels being laid by the Electric Boat Company this year. The keel of the Perch was laid on February 25, and that of the third submarine, the Pinna, is scheduled to be laid about June 1.

* * *

Study Shows Excellence of Puritan Descendants. In a very interesting study, just recently completed by Professor Ellsworth Huntington of Yale University and Martha Ragsdale, descendants of Puritan ancestors are found to be above the average in achievement and presumably in innate ability and power of self-control. The results of the study will be released soon under the title of "After Three Centuries a Typical New England Family."

Professor Huntington, prominent for his population studies and as a geographer, outlined the kind of country we might now have if the people of America were all descendants from selected ancestors like the Huguenots, Quakers or Puritans. He states that if the birthrate of the old colonial Americans had not declined and the Puritans had formed the great bulk of the present population, contrasts might be noted as follows:

1. Population would be blonder and more blue-eyed than our present people, and possibly more urban, but would be living largely in the suburbs and not in the cities themselves.

2. Farmers and laborers would be only half as numerous as at present.

3. Skilled laborers would be as numerous as now; clerks would be 50 percent more numerous, and business executives twice as numerous. Professional men in general would be four times as numerous and engineers, doctors, writers and professors from five to nine times as numerous.

4. Educationally, the contrast between a community of Puritan and non-Puritan origin would be much greater.

5. Crime as well as dependency of the type that demands public relief would be only half as prevalent as now.

6. Persons of real distinction of the type who lead human progress and become embedded in encyclopedias, would be 10 or more times as numerous as at present.

Numerous other contrasts were named. The study as a whole, Professor Huntington asserted, "seems to provide a strong argument for eugenics as well as for good training."

* * *

Palmer Brothers Plant Closed. The Board of Directors of the Palmer Brothers Company recently decided to close its New London plant and concentrate all of its manufacturing activities at the Fitchville plant. It is understood that this step was taken to preserve the interest of the company which has faced a deficit with the operation of the two plants. The New London plant has employed from 100 to 300. The company's principal products are comfortables and curtains.

Degree-splitting characteristics control any heating process

Other features of Bristol's Pyrometer Controller, Model 478, are: mercury-to-mercury electric contacts sealed in glass, no need for relays, visible operating mechanism, accessibility of telechron motor, mercury switches and terminal block simplifying inspection, safety, accuracy, simplicity.

THE BRISTOL COMPANY, Waterbury, Connecticut.

TRADE MARK BRISTOL'S REG. U.S. PAT. OFF.

PIONEERS IN PROCESS CONTROL SINCE 1889

Baum Plant to Locate in Bristol. The H. C. Baum Company, electroplaters, whose building in Plainville was destroyed by fire Sunday night, March 17th, is being re-established in Bristol, according to President H. C. Baum. The company has been operating in Plainville for twenty-one years, employing approximately thirty-five persons.

The fire loss was estimated at $50,000, and included among the equipment destroyed was a chromium plating unit recently installed at a cost of $8500.

* * *

Belamose Changes Name. The name of the Belamose Corporation of Rocky Hill was changed on April 1 to the Hartford Rayon Corporation, a title the company feels is more descriptive of its location and product. According to the announcement no change was made in management or personnel.

The company started operations in 1924, producing rayon in skeins for sale through wholesale channels to manufacturers of woven or knit goods. Most of the company's highly technical processes require extremely careful chemical and mechanical control, and most of the operations are conducted in departments which are completely air conditioned.

Operations of the company for the past six months have been at full capacity utilizing the services of approximately 700 employees who reside at Middletown, Rocky Hill and Hartford.

Officers and directors re-elected at the company's recent annual meeting were as follows: President, John C. Cosceboom; vice-president, L. F. Dettenborn; vice-president and general manager, G. T. Loveridge; treasurer, C. D. Healy; secretary, John C. Parsons; assistant secretary, Katherine A. McCarthy.

* * *

Death of Clifford R. Gardinor. Clifford R. Gardinor, 60, president of the International Silver Company, director and member of the executive committee of the Manufacturers' Association of Connecticut for a term ending January 1, 1935, died at the Meriden Hospital on April 6th, three days after undergoing a gall bladder operation. Mr. Gardinor's sudden death came as a distinct shock, since he was apparently on the road to recovery when the sudden turn for the worse ended his life early in the afternoon. His business associates reported that his health had been failing for some time previous to his operation.

A native of Jersey City Heights, N. J., Mr. Gardinor located in Meriden about 25 years ago where he became associated with the International Silver Company. His rise in the organization was rapid, and in 1928 he became president succeeding George H. Wilcox, who was made chairman of the board.

Prior to his connection with the International Silver Co., Mr. Gardinor had been connected with the Westinghouse Electric Company at East Newark and Pittsburgh; the National Cash Register Company at Dayton, Ohio, and the Columbia Graphaphone Company of Bridgeport. He was widely known not only throughout the silverware industry but among others affiliated with it and those with which he had been connected before entering the employ of International.

He was a member of several Masonic bodies, a trustee of the First Congregational Church of Meriden, president of the Home Finance and Mortgage Company, trustee of the Meriden Trust and Safe Deposit Co., director of the Home National Bank of Meriden, former president of the Highland Country Club in Westfield and of the Meriden Manufacturing Association and the Meriden Chamber of Commerce.

Mrs. Gardinor, who had been ill, was reported to be in serious condition immediately following the news of her husband's death. Besides his wife, Mr. Gardinor leaves a daughter, Mrs. Henrie Prunaret of Wellesley, Mass., and a brother, Frank F. Gardinor of Trenton, N. J.

Out of respect, all offices and factories of the International Silver Company, in the United States and of the International Silver Company of Canada, Ltd., were closed on April 9th, the day of his funeral. Services were held at the First Congregational Church of Meriden at 2:30 p. m. and burial was made in Walnut Grove Cemetery, Meriden. Honorary pallbearers were F. H. Billard, W. B. Church, W. W. Gibson, Arthur S. Lane, W. J. Luby, C. D. Munson, George J. Sokel, E. C. Stevens, B. M. Tassie, George H. Wilcox, Roy C. Wilcox, E. B. Wilcox, George H. Yeomans, all of Meriden; Colonel A. H. Dickinson, of Waterbury; John M. Hancock, R. D. McGrath and G. H. Neimeyer of New York; E. Kent Hubbard of Middletown; Albert H. Powell of New Haven and L. H. Wetherell of Boston.

* * *

Strike News. The strike at the Cyril Johnson Woolen Mill at Stafford Springs, Conn., which had been in progress approximately 11 weeks, ended March 29th after a visit by Carl Gill, conciliator sent to the plant from Washington by the National Textile Relations Board. The strike was unusual in that hours and wages were not a part of the dispute, the walkout being caused by the refusal of the company to comply with the union demand to dismiss two employees, classed by the union as strike-breakers. The two men continued to work throughout the walkout period and are still working for the company at the end of the strike.

About 60 employes of the Capewell Horse Nail Company, Hartford, went on strike April 12 in protest against the discharge of 8 employes, five of whom were said to have union affiliations. A conference of the management and strikers with the State Labor Department was immediately scheduled but held over to the week of April 14th. Union officials claim that the majority of workers in the plant are affiliated with the Horse Nail Workers' Union which is a branch of the A. F. of L.

About 300 weavers of the Bigelow Sanford Carpet Company, Thompsonville, who walked out in protest against the hiring of 30 learners, on March 12, returned to work Wednesday, March 20, after a satisfactory adjustment was finally effected at two long conferences of the management and labor representatives in the office of the State Labor Commissioner. Atlhough it was thought at the time that the adjustment would obviate the possibility of a strike, early in April strike possibilities over wages again became apparent with a strike vote scheduled for April 18.

The Textile Labor Relations Board recently found the E. E. Hilliard Company of Buckland guilty of violating Section 7-A of the Recovery Act because the concern had failed to rehire a number of former strikers. After 15 days when the company had not rehired the strikers, the Labor Relations Board referred the company to the Compliance Division, which requested the Blue Eagle.

DEPARTMENTS

Accounting Hints for Management

Contributed by Hartford Chapter N. A. C. A.

Group Bonus. For years industrial management, aided and abetted by industrial engineers and accountants has endeavored to perfect group piecework and wage incentive plans in order to increase production, reduce costs, and achieve a greater degree of control. It is, therefore, a decided jolt to learn that the motor industry, operating under highly organized and efficient management, is gradually discarding the group piecework and group bonus plan of paying workers, substituting the straight hourly rate. This development prompts the inquiry into the merits and defects of the two plans.

The prime motive in the adoption of the various incentive plans has been to give employees added incentive in their tasks which would be reflected in the most tangible form—the payroll. It has stimulated production largely through cooperative efforts of the workers. This plan has also served to lessen the necessity of supervision as certain members in each group would always be alert to detect any shortcomings in the operations of their fellow workers.

On the other hand there are certain admitted objections to such plans. Usually the worker has no idea of the group production; he has no definite basis for determining his income, and often has misgiving as to the correctness of his compensation. It has created a certain amount of friction amongst employes, as it has thrown men of varying ability into groups with less capable operators. Another factor has been that the operators were frequently penalized for delays and lack of production which were beyond their control, such as breakdowns, and lack of materials for operation. There is a definite advantage to management under the day rate plan, as employees are more willing to be transferred to other tasks if they know the pay envelope will not suffer.

The criticisms have recently been stressed by organized labor, so that the abandonment of the plan does in a measure represent a concession in the interest of harmony and better understanding. As a matter of fact there is not a great deal of difference in total labor costs under the two schemes.

The action of the motor industry in this vital matter is provocative of serious thought to similar questions in other industries.

Final Meeting—"Normal Overhead." The last technical meeting of the season will be held by Hartford Chapter, N. A. C. A., on May 21, 1935, at the Elm Tree Inn, Farmington. The subject of "Normal Overhead" will be discussed by three prominent Chapter members: Joseph E. Simmons of Arrow, Hart & Hegeman Co., Herman Papenfoth of Trumbull Electric Manufacturing Co., and Ivan Coulter of the Scovill Manufacturing Co.

Transportation

I. C. C. Denies Freight Rate Increase. Application of Class I railroads of the United States and certain other carriers to make increases in freight rates and charges in various amounts, generally 10 percent of present rates and charges, has recently been denied by the Interstate Commerce Commission. Instead, the Commission has authorized the carriers to add certain emergency charges to existing rates on a large part of their freight traffic for a period to end June 30, 1936. In a large measure, these emergency charges are similar, except in amounts, to those which were authorized by the Commission in the Advanced Rate Case of 1931 (ex Parte 103) and which were in force from January 4, 1932, to September 30, 1933.

The emergency charges authorized may be summarized, generally speaking, as follows:

1. Charge on carload traffic in general is 7% of the total line haul transportation charge based on present rates, but not more than 5¢ per hundred pounds. Specific minimum charges taking precedent over the 5¢ maximum are provided on a long list of commodities.
2. No charge is authorized on less carload traffic for distances less than 220 miles, and for greater distances the charges range from 1¢ to 11¢. No emergency charge on less-than-carload traffic shall be in excess of 10% of the line haul transportation charges.
3. An emergency charge of 10% is authorized in connection with switching and certain other accessorial charges, subject to exceptions.
4. The carriers' proposal to authorize a charge for issuance of order bills of lading is disapproved.
5. On coal and coke, charges ranging from 3¢ to 15¢ per net ton are authorized. (The 15¢ increase would apply to New England.) The charge on petroleum products is 1¢ per hundred pounds.

Although the Association was represented at the hearings in this proceeding (ex Parte 115) and questioned the advisability of any increase in rates, it suggested that if increases were necessary, they should be authorized on some basis other than by percentage increases, a method largely followed out by the Commission in this decision.

* * *

Motor Carrier Legislation. On April 8th, the Senate Interstate Commerce Committee voted to approve the Eastman highway bill, S. 1629, with certain amendments. One change made in the Eastman bill by the committee would give the Commission jurisdiction over qualifications of and maximum hours of service of motor carriers employes, which would extend to employes of common, contract and private carriers.

The committee also amended the bill to provide with respect to establishment of joint rates and through rates, that the Commission could require the establishment of such rates and routes as between bus lines only. It makes the establishment of joint rates and through rates permissive between truck carriers and other carriers, including highway, rail or waterway. It is understood that the general scheme of regulation by the Interstate Commerce Commission provided for in the Eastman bill was approved by the committee.

* * *

Master Tariff Issued on Advance Freight Rates. In accordance with the permission granted by the I. C. C., the carriers issued on April 10 a master tariff which sets

forth the advance freight rates which became effective on April 18, 1935, and names the emergency charges which the carriers have been permitted to add to the basic rates. Many states have thus far not permitted the rates to become effective on intrastate traffic on April 18, but it is assumed that at least a great majority of these states will permit the increases upon the statutory 30-day notice. Increases in the intra-state rates in Connecticut became effective April 18.

* * *

Industrial Sand Cases, 1934. The effective date of the order in the Industrial Sand Cases has recently been postponed by the Commission from June 1 to July 1, 1935. On several previous occasions, the effective date has been delayed because of the enormous amount of work entailed in compiling the tariffs, which resulted in several petitions by the carriers for an extension of time to complete the work.

In accordance with the terms of the Commission's order in this proceeding, mileage rates were established for the movement of industrial sand throughout Official Classification. The new rates are in most instances substantially lower than those now in effect and will cause a considerable saving to consumers of sand in New England procuring their products from the Albany district, the New Jersey section or from points in New England.

* * *

American-Hawaiian Appoints New Officials. In recognition of long and efficient services, the board of directors of the American-Hawaiian Steamship Company, oldest and largest of the intercoastal carriers, recently elected Thomas G. Plant and Walter S. McPherson, vice-presidents. Plant has served American-Hawaiian since 1907, having been operating manager since 1923. He will continue to have charge of all operating matters. McPherson, who joined the company in 1909, has been Traffic Manager since 1928. He will retain his headquarters in New York City.

* * *

New Haven Revenues Up—Deficits Increase. In its recent annual statement, the "New Haven" Railroad disclosed that despite the first yearly increase in gross revenue since 1929, the company incurred a deficit after fixed charges in 1934 of $5,532,114 or $678,282 more than in 1933.

The mountaing deficit in the face of increased revenues was ascribed by Howard S. Palmer, president, to a number of factors, including higher cost of fuel and other materials arising from recovery administration code requirements, restoration of wage reduction on July 1, 1934, and extraordinary expenditures due to severe weather early in 1934. President Palmer also pointed to an increase in the tax item which amounted to $66,873 more than for the previous year, bringing the total of taxes paid to $4,-511,878.

Foreign Trade

President Outlines New Foreign Policy. President Roosevelt, on April 1, proclaimed the new Belgium-American Reciprocal Trade Agreement, effective May 1, and at the same time addressed a letter to Secretary Morgenthau, outlining this country's foreign trade policy, in which reprisals were threatened on nations discriminating against American goods. Pending the conclusion of negotiations for a new pact, now in progress, the reduced rates and other concessions granted Belgium will be extended to Canada, Spain, the Netherlands, Switzerland and Liechtenstein for six months.

The President let it be known that countries granted the 6 months preferential treatment are expected to complete the negotiations of new reciprocal pacts with the United States within that time. The tariff concessions given to Belgium are being generalized only provisionally to Germany, Italy, Denmark and Portugal and its colonies, because these countries are now discriminating against American goods. Under this provision, the President warned, existing treaties with these countries may be abrogated and the favorable treatment ended upon 30 days' notice.

In extending the benefits of the Belgian pact to 64 named countries and their possessions, the State Department warned that since some of them were "slightly discriminating" against American products they were on their good behaviour and that "acts and policies will be studied and at a later time, if it should appear that discriminations against American trade are substantial, or if they should be increased substantially, consideration will be given to the withdrawal on our minimum duties from such countries." Members interested may secure complete discussion of this subject from Association headquarters. Members will be informed of any discriminatory action taken against any countries or country.

* * *

Changes in Canadian Tariff and Taxation. In the recent Budget Speech presented to the Canadian Parliament March 22, a number of changes in tariffs and taxation which became provisionally effective March 23, were summarized under the two headings as follows:

1. Those affecting our Canadian trade include the special excise tax which has been entirely eliminated on goods free or dutiable under the preferential rate and on goods covered in Canadian trade agreement with other empire countries. The rate under the general (which applies to United States Goods) and intermediate column remains at 3 percent. Excise tax on cigarette lighters is now 20 percent and when combined with pencils, cigarette cases, et cetera, 10 percent on combined value. Numerous changes are made on preferential duty which space does not permit enumerating, but which will be forwarded to interested members on request.

2. Other changes affecting Canadian revenue, or income tax changes, show an increase in the corporation tax from 12½ percent to 13½ percent, which consolidated returns have been further restricted and made taxable at 15 percent instead of 13 percent. The surtax on investment, or unearned income, is 2 percent between $5,000 and $10,000, and 3 percent between $10,000 and $14,000, and over $14,000 income has been defined as investment income with graduated rates up to 10 percent on $200,000 and over. The gift tax of 2 percent has been made applicable on gifts of $1,000 to $25,000, graduated upward to 10 percent on gifts of $1,000,000 and over. The object is to deter transfers largely within families as a means of reducing liability under personal income tax. The Canadian companies controlled by non-residents through shares, affiliations or by agreement, may not deduct in income tax returns payment to non-residents for management fees, services, use of patents, processes or formulae, all of which affects U. S. companies with Canadian branches.

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An alphabetical list of accessible services recommended to Connecticut Industry readers

HADFIELD, ROTHWELL, SOULE & COATES
Certified Public Accountants
Hartford — Stamford

HENRY KNUST
Certified Public Accountant
Conn. and N. Y.
15 Lewis Street — Hartford

Scovell, Wellington & Co.
ACCOUNTANTS AND AUDITORS
First National Bank Bldg.
New Haven
Offices in Principal Cities

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T. A. D. JONES & CO., INC.
24 hour service to Connecticut Industries
New Haven — Bridgeport

ENGINEERS—MANAGEMENT
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First National Bank Bldg.
New Haven
Offices in Principal Cities

DIESEL ENGINES
WOLVERINE MOTOR WORKS, INC.
6 Union Ave. — Bridgeport

ENGRAVERS
DOWD, WYLLIE & OLSON
Advertising Art & Photo Engraving
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THE JOHN P. SMITH CO.
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PITT & SCOTT CORP.
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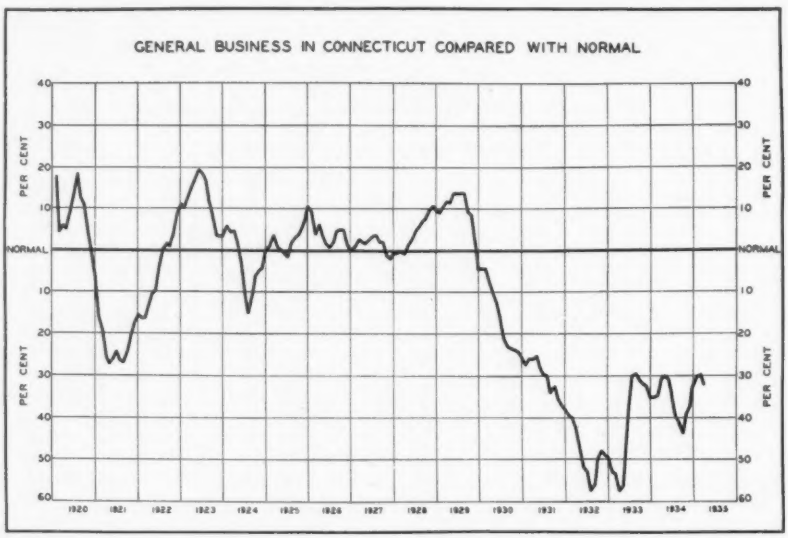
BUSINESS PATTERN

General Summary. General business activity in Connecticut declined to 32% below normal in March compared with 30% below in February. This was the first decrease in the general business curve in six months and was the result of an unusually sharp falling off in car-loadings originating in Connecticut cities and in cotton mill activity. The number of man-hours worked in five cities increased 3% over February, which was considerably larger than the usual seasonal gain; as a result this index was at the highest level since December, 1930. Factory employment in ten cities also expanded more than seasonally in March and was likewise above any previous month since the end of 1930. The bank debit index increased substantially over February and in the four weeks ended April 10 was 8% higher than in the corresponding period a year earlier. Metal tonnage carried by the New Haven Road decreased in line with total car-loadings. Data available for the first week of April indicated a continuing divergence in current trends of business activity. Employment and the number of man-hours worked in factories in one large city were higher than a month earlier but the daily average of freight car-loadings originating in Connecticut was lower than in March, contrary to the usual seasonal trend.



In the United States general business activity also moved downward moderately in March. This was due to the sharp contraction in cotton consumption and to smaller decreases in pig-iron production and in steel. Freight car-loadings and electric power production were moderately lower than a month earlier. The production of automobiles increased seasonally over February and the total was the highest on record for that month with the exception of 1926 and 1929. During the first half of April, weekly production continued to mount as the result of a sustained retail demand, production in the week ended April 13 being the highest for any week since August, 1929. The weekly business index of the New York Times fell sharply during the first week of April largely as the result of curtailment programs in certain sections of the cotton textile industry, and also because of the substantial reduction in freight car-loadings of bituminous coal, loadings having been high in March due to the possibility of a coal strike April 1.

Wholesale prices, according to the index of the United States Bureau of Labor, declined fractionally during the four weeks ended April 6. During that period the price of farm products fell off 2%, while foods advanced 1%. The index of the prices of all other commodities declined less than one-half of 1%. Since April 6 there has been a sharp rise in wholesale prices partly as the result of the inflationary implications of the advance in the price of silver.

The cost of living index of the National Industrial Conference Board showed no change in March compared with February. Of the component items, food and clothing decreased slightly while the price of rent advanced almost 1%. Compared with a year ago, food prices in March had risen 12% and rent 8% while the prices of clothing, fuel and light, and sundries were approximately the same as last year.

Finance. During the four weeks ended April 6, the number of business failures in Connecticut increased 84% over the same period of 1934, and was also considerably above 1933. Gross liabilities of failures, although 30% above a year ago, were, nevertheless, relatively low. The number of new corporations formed was 17% below 1934 but the total capital stock involved increased 1%. The

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real estate market showed signs of increasing activity in March and early April, the number of real estate sales being some 39% above the level of last year. The value of mortgage loans, however, remained at an abnormally low level.

Construction. Building activity in Connecticut experienced a sharp seasonal rise in March with the total number and the value of building permits issued exceeding last year by 48% and 62% respectively. On April 3 work was started for a new chemistry building for Trinity College in Hartford to cost $400,000.

Labor and Industry. As mentioned above, activity in Connecticut manufacturing plants expanded more than seasonally in March. The index of the number of man-hours worked stood at 28½% below normal compared with 30% below in February, and 34% below a year earlier. In Bridgeport, New Britain and New Haven, expansion in industrial activity was considerably larger than seasonal and in Bristol there was a nominal gain in activity. Compared with a year ago, all cities reported substantial increases. Employment in Hartford factories increased 2½% in March over February and was 2% higher than in March, 1934. On the other hand, employment in Waterbury brass factories was 1% below February and approximately 5% below last year's level.

Available data indicate that factory employment and payrolls in manufacturing establishments in the United States both increased somewhat more than seasonally in March. During the past several months, increases in activity in the durable goods industries have been much larger than in the non-durable or consumers' goods industries.

Trade. There was a sharp advance in retail trade in the United States during March, the index of sales by department stores, after correction for the usual seasonal changes, rising to 80% of the 1923-25 average compared with 75% in February and only 72% in January. Sales by leading mail order houses and chain stores indicated that this improvement was widespread.

Transportation. The index of freight car-loadings originating in 14 Connecticut cities declined abruptly to 41% below normal in March compared with 35% below in February. Car-loadings of merchandise in less than carload lots increased less than seasonally over February and was 7% below last year. Loadings of automobiles and bituminous coal were at a high level.

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MACHINE TOOLS

(Continued from page 10)

and mechanical appliances, is traceable directly to the first successful application of the system, in 1798, by Eli Whitney of New Haven, Conn., in the manufacture of muskets for the government. Whitney, a mechanically minded young man who had earned his way through Yale by making nails and doing other mechanical jobs, had in 1792, invented and built the cotton gin in the basement of the Greenville, South Carolina, home of Nathaniel Greene's widow. Its economic effect on cotton growing and manufacture was quickly felt throughout the civilized world, but the only effect it had upon Whitney was to rack his nerves and lose more money for him than it ever gained, for the patent laws were such at the time that it was practically impossible for him to defend his patent rights to this highly valuable invention. By 1798 he had made up his mind to give up further attempts to defend his rights in the courts and to enter into the manufacture of firearms on a "new principle," as he chose to call the system he had in mind. Accordingly he wrote to Oliver Wolcott, Secretary of the Treasury, advising that he should like to undertake the manufacture of ten to fifteen thousand stand of arms which he believed could be facilitated by proper machinery moved by water, etc. He got the contract and immediately started to build his arms factory at Whitneyville, just outside of New Haven. Since he had to design his own machinery including forging machines, rollers, machines for floating, boring, grinding, polishing as well as all jigs and fixtures, it was nearly two years before the plant was in operation.

Because the government had advanced so much money on this first contract without a single gun being completed for a long period, French and English ordnance officers were ridiculing Whitney's "new idea" of manufacturing the "same parts of different guns as much like each other as the successive impressions of a copper engraving." Washington officials became uneasy and asked for explanation of his slowness and proof of his ability to produce economically and satisfactorily under the new process. Whitney went to Washington, and to forever quell the skepticism of officials, he took along with him ten pieces of each part of a musket, exhibiting them to the Secretary of War and army officers in a succession of piles. Selecting indiscriminately from each of the piles he put together ten muskets much to the amazement and conviction of the onlookers. (Date believed to have been about 1800.)

Meanwhile Simeon North, of Berlin, Conn., a maker of pistols by trade, had completed his contract of 1799 for 1500 pistols and received and executed others. Letters written by North in 1808 and 1813 indicate that he was employing a division of labor and using interchangeable parts, but whether he developed this idea "on his own" either prior to Whitney or afterward, is not definitely proved. Grandsons of Simeon North claim for him the honor of preceding Whitney in the utilization of the interchangeable parts system. The available written evidence gives precedence to Whitney in being the first to apply the system successfully. Of the two, Whitney was by far the most influential in spreading the interchangeable system throughout the country, undoubtedly because he was well and favorably known by his invention of the cotton gin and being located in a larger center. Although it took Whitney eight years to complete his first arms contract, due to the necessity of building all of his tools and factory, government officials had developed such a high regard for him that they had, by the completion of the contract, advanced him all but $2,450 of the $134,000 to be paid for the guns. Following this contract he received numerous other contracts and was called upon to furnish some of his best workmen to introduce his interchangeable system at the Springfield Arsenal and later at Harper's Ferry—the two arsenals authorized for the manufacture of small arms in 1792.

The business started by Whitney was carried on for years after his death by his nephews, Eli Whitney Blake, later inventor of the Blake stone crusher and Philos Blake, and still later by ex-governor Edwards, a trustee of the estate. From 1842 to 1888 his son Eli Whitney, Jr., managed the business. The son was mechanical like his father and continued to develop the art of gunmaking, introducing improvements in barrel drilling and also the first use of steel for barrels. In 1888 the plant was sold to the Winchester Repeating Arms Co.

Although Whitney's invention of the cotton gin ranked in economic importance with the invention of the steamboat and telephone, in the opinion of many, his practical system of interchangeable manufacture and division of labor, which he helped to propagate throughout the state and nation, was of far more importance economically than any single invention. As a notable incident to mass production and distribution, Whitney's system has been the most potent stimulant of all time to the growth of the machine tool industry. The very system itself caused Whitney to develop many new tools, notably his milling machine of 1818, a possible inspiration for the Lawrence miller, brought to the Sharps Rifle factory in Hartford about 1851, and from which the famous "Lincoln" miller design is said to have been copied in many details by Francis A. Pratt. It was made by Amos Whitney, a contractor for the Chas. L. Lincoln Co., who sold it to Colt's Armory in 1855.

The next and probably most important early step in the development of the Connecticut influence, was the construction of the great Colt's Armory in Hartford, in 1853-54, its equipment with automatic or semi-automatic machinery and the adoption of the interchangeable system of manufacture with its consequent division of labor.

Samuel Colt was born in Hartford in 1814, son of a dye manufacturer of Ware, Mass. After an adventurous boyhood during which he shipped before the mast to Calcutta before age 16, he returned to work in his father's dye works at Ware where he learned a smattering of chemistry. But while being blown to Calcutta he had plenty of time to think and whittle; the two resulted in his first crude cylinder revolver model. To secure funds for the development of his invention he took to "the road," on lecture tours, advertising himself as Dr. Coult. Laughing gas demonstrations were his specialty, and he probably administered more of the gas than any other man since chemistry first became known. In 1835 he went to England and secured a patent and the following year took out his first American patent and organized the the Patent Fire Arms Co. of Trenton, N. J., and tried for the adoption of his revolver by the U. S. Government. Failing in the attempt for two successive years he concentrated on the market on the Texas frontier, where his grip on the "rough and ready" men of that country became so strong that it has never been lost.

By 1840, after his repeating revolver had demonstrated its effectiveness in Texas and other parts of the Southwest, the Seminole War gave him his opportunity to demonstrate the value of his product. But even that resulted in only two small government orders amounting to 160 weapons. The Mexican War turned the tide and brought two sizeable government orders, which Colt had manufactured for him at the Whitney Armory in Whitneyville.

In 1848 he moved to small rented quarters in Hartford and started his own manufacturing patterned after the Whitney system. Increasing orders soon made it necessary for him to seek larger quarters. Always the showman, he decided to do things in a big way and therefore built on the present site of the Colt's Patent Fire Arms Mfg. Co. plant, what was then the most modern and sizeable Armory in the world. It was constructed in the form of an H, 3½ stories high and 500 feet long and contained over 1400 machines, the majority of which were built in the factory under the supervision of Samuel Colt's ingenious superintendent (later president of the company for many years), Elisha K. Root, whom he had seduced from the Collins Co., of Collinsville, in 1849, by a salary offer, said to be the largest paid to any manufacturing official in the country at the time. Root, a Massachusetts farmer boy had served an apprenticeship and had worked at Ware and Chicopee Falls prior to coming to the Collins Co. as a lathe hand in the repair shop. Within a comparatively short time his mechanical ability elevated him to the point where he was practically in charge of the plant. Largely through his inventions and methods the Collins Co. was changed over from a primitive to a modern shop which laid claim on both American and export markets.

So well did Root plan the Colt factory and its machines that the Armory is still considered one of the best private gun making plants. Many of the machines are still running, holding their own for accuracy and economy of production. As previously mentioned, Lincoln millers and a few other machines for Colt's Armory were built at the Charles L. Lincoln plant in Hartford. A few among the machines designed by Root and built under his direction were machines for boring, rifling, making cartridges, stock turning and splining. In addition he worked out the entire system of jigs, fixtures, tools and gauges as well as inventing for use in the plant the best form of drop hammer ever produced up to that time.

It is doubtful if Connecticut or New England ever produced an abler mechanic than Elisha K. Root. He was not only a mechanic and inventor of unusual ability, but also a wise executive whose influence extended beyond things mechanical into flesh and blood, for under him worked at different times, S. A. Pratt and Amos Whitney, later founders of Pratt and Whitney; Charles E. Billings and C. M. Spencer, founders of the Billings and Spencer Company; George A. Fairfield who organized the Hartford Machine Screw Company and a number of others who were influential either in other machine tool plants or in organizing one of their own in New England or the middle west tool building area. In many respects, Mr. Root was like Maudslay of England, who not only built beyond his time in machine tools, but also like a good parent, reared a family of excellent mechanics and inventors who continued to extend the influence of the master.

About 1851, shortly after Samuel Colt was properly settled in his rented quarters in Hartford, a company was formed in the city to manufacture the breech-loading rifle, invented in 1848, by Christian Sharps. Coming from Windsor, Vermont, bringing with him the first miller seen in Hartford, Richard S. Lawrence became master armorer in the Sharps plant, which did a large business for a number of years, using both the contract and interchangeable parts system. The contract system then in vogue in the majority of shops of that period, among which the Colt Armory was included, was an excellent training for future manufacturers, since the company furnished all materials, machinery, tools, shop room and supplies, while the workmen were employed by the contractor, their wages being paid by the firm and charged against the contractor's account. In the true sense of the word, a contractor of this day was actually operating his own small business, except that he had no capital invested but his time. After the Sharps business had been moved to Bridgeport, the plant was sold to the Weed Sewing Machine Co. where C. E. Billings and George A. Fairfield, former "Colt" men were at one time superintendents. In this plant, the first Columbia bicycles were produced for the Pope Manufacturing Company of Boston, after which the latter concern purchased the plant which shortly became one of the greatest bicycle factories in the world, as well as being an early manufacturer of automobiles. In both the Weed and the Colt plants, other arms manufactories such as Smith and Wesson, originally of Norwich; the clock industry, located in the vicinity of Bristol; the watch industry at Waltham, Mass., and many others, the new interchangeable system of manufacture and division of labor, was adopted, thereby expanding production tremendously, while reducing prices.

Although the story of the rise of the brass industry in the Naugatuck valley, starting in reality about 1802, was told in the July, 1934, issue of this magazine, it would be an oversight not to mention the large amount of machinery designed and built for the most part by mechanics in those plants. At first these companies managed to import a few English machines, rollers and finishers as well as to bring in by under-cover methods, English workmen. But within a short time Yankee observation and natural mechanical ingenuity was sufficiently developed to devise and build all the machinery necessary for making brass and copper sheets, rods, tubing wire and for such fabricating machinery as those for making eyelets, hooks and eyes, pins, cartridges, and many others. Much of this machinery has never been made public, and nearly all of it is too intricate for description. From the fact that these tools are so specialized in their nature and have never been offered commercially, it is little wonder that the mechanics who devised them are little known, with the exception of Hiram W. Hayden, inventor of the spinning process and Dr. J. I. Howe, inventor of pin making machinery. Nevertheless this group of tool builders who have been a vital element in the phenomenal growth of the brass industry (No. 1 in Connecticut) should be recognized as among America's most successful and able tool builders.

To obtain a clearer picture of the American scene and Connecticut's importance in it, from the period starting about 1838 through the 50's, brief mention of certain developments at Windsor, Vermont, should be made. Previously we have noted the spread of manufacturing by Pawtucket and Providence mechanics to other centers in Massachusetts, New Hampshire, Vermont, and Philadelphia. One of these important centers was the backwoods town of Windsor, Vt., where the manufacture of firearms

was started early by small custom gun shops. From this mechanical seed there germinated about 1838 the Robbins & Lawrence Company, which built firearms by the interchangeable process, from which four great mechanics came to build up their lines of influence elsewhere, either through their connection with existing companies or through being instrumental in organizing new ones. These men were: Frederick W. Howe whose influence was extended to Providence; Henry D. Stone who continued his influence at Windsor; Richards S. Lawrence, one of the founders of the company, who came to Hartford as master armorer of the Sharps Rifle Co.; Charles E. Billings, who after learning his trade came to Hartford to work at Colt's Armory at the age of 21 as a die sinker and tool maker. The Lawrence influence is seen in the development of the Lincoln miller, since he is said to have brought with him to Hartford the first plain milling machine ever used in the city, the design of which was followed closely by Francis Pratt when designing the first Lincoln miller. Lawrence also applied the broaching process with great economy in the manufacture of Sharps Rifles, and was the inventor of the split pulley made for him by Lincoln's Phoenix Iron Works. In reality Lawrence can well be classed as one of Connecticut's own mechanical geniuses since he spent about 24 years of his mechanical working life in the state as compared to 10 in Vermont, and the remainder of it as a Hartford city official.

Charles E. Billings, the other mechanic and inventor, whose influence was distinctly a part of Connecticut's contribution to American tool building, has already been mentioned as one of Colt's famous workmen. From Colt's in 1862 he went to E. Remington & Sons where he built up their forging plant to an efficient unit. Returning to Hartford after the war, he worked for the Weed Sewing Machine Co. and for the unsuccessful Roper Repeating Arms Co., of Amherst, Mass., and then with Christopher M. Spencer organized, in 1869, the Billings and Spencer Company, of Hartford. This company has probably done more than any other for the art of drop forging, not only in developing the modern board drop hammer, but in extending the application and accuracy of the process.

Thus far in our story we have seen the lines of mechanical influence moving from South to North, zigzagging and returning south again, but most lines in some way have led to or from Colt's model armory, which, without doubt, was the earliest and most influential of all training schools for American tool builders, as well as being the tabernacle from which issued a more refined gospel on the interchangeable parts system of manufacture than afforded at the Whitney Armory.

To mention a few of Colt's workmen and their accomplishments, let us start with Professor Charles B. Richards, who was engineering superintendent under Mr. E. K. Root. Although more of a consultant and inventor than a tool builder, he invented the Richards steam engine indicator, aided in the development of the first high speed steam engine, and was a factor in improving methods and machines at Colt's. Dating from 1884 for 25 years, he was Professor of Mechanical Engineering at the Sheffield Scientific School of Yale.

William Mason, a quiet, kindly man who learned his trade at the Remington Arms Co., at Ilion, N. Y., was for 16 years superintendent of Colt's Armory. During his employment at Colt's and his subsequent 28 years with Winchester Repeating Arms Co., as master mechanic, he secured 125 patents, most of which were in connection with arms and ammunition, and tools for their manufacture. Others included appliances for looms and weaving, steam pumps, etc.

Asa Cook who afterward became a designer and manufacturer of machinery for making wood screws, served for many years as a foreman at Colt's. George A. Fairfield, another Colt's foreman, was one of the organizers and first president of the Hartford Machine Screw Co., organized to make Christopher M. Spencer's invention, an automatic turret lathe to cut screws automatically. To assist Fairfield in the organization of this company, Spencer, also a former Colt's mechanic, withdrew his active connection with Billings and Spencer. But with a natural leaning toward invention, especially in the firearms field, he withdrew from the Hartford Machine Screw Co. in 1882, six years after its organization, to start the Spencer Arms Co. of Windsor, which manufactured his own invention, a repeating shotgun. Although the gun was a success, the company failed, bringing severe losses to Spencer. Thereafter he returned to the design and improvement of automatic lathes where he did his most brilliant work.

Besides E. P. Bullard and Gleason the only other Colt's mechanics who seem to warrant discussion in this article are: Francis A. Pratt and Amos Whitney, who will be discussed in the history of the Pratt and Whitney Company. Likewise Mr. Bullard will be mentioned in the history of the company he founded, now known after several changes of name as The Bullard Co.

The second big training school for mechanics which has perhaps trained more actual machine tool designers than Colt's was Pratt and Whitney. From this company went at least a dozen men to form companies in the middle west and a few in New England.

Of the Connecticut mechanics, with the exception of Eli Whitney and E. K. Root, it is probably safe to say that the majority of their inventions were either new applications of old ideas lying dormant, or material improvements on existing ones, since a start had been made by 1850 in practically the entire machine tool family. But that fact does not detract in the least from the abilities of the later inventors and developers, for often their improvements had more far-reaching economic importance than the pure invention of the first crude models.

Thus by applying power and changing the shape and size to suit the need, the hand tools of nearly two centuries ago have been transformed to do miracle tasks in metals. The results of that far-reaching evolution brought about by a comparatively few hundred relatively obscure inventors and mechanics have completely transformed the living standards of two continents and are rapidly making inroads on the remaining ones. The inventor and developer is forever ringing down the curtain on the "good old days" we have always heard about from those who think they would like to go back to them. In reality that thought is merely a mental trick which focuses the mind on pleasant associations of the past, making them seem more romantic with the passing of years. To test the true desire of the man who is forever yearning for the "good old days," just start enumerating the things he must forego if he would lop off a century or even 50 years. From that experiment, unless your prospect is an out-and-out dogmatist, both of you should come to appreciate more fully the work of machine tool builders of yesterday and today who have wrought miracles in metals.

EDITOR'S NOTE: *The following are the first four individual history sketches of Connecticut machine tool builders. Lack of space makes it necessary to publish the histories of 14 other companies in the June issue.*

Pratt and Whitney

Two men, Francis A. Pratt and Amos Whitney, born in New York and Maine in 1827 and 1832, were apparently destined to make their marks in the field of mechanics. Pratt was trained under a thorough mechanic and wise teacher of the old school. Whitney, a distant relative of Eli Whitney, apprenticed at the Essex Machine Works of Lawrence, Mass., and worked one year as a journeyman. At the age of 18, Whitney followed his father to "Colt's Pistol Factory" (1850) in Hartford. About three years later Francis Pratt went to work for Colt's and after two years' training was invited to become superintendent of the Phoenix Iron Works. Shortly afterwards Amos Whitney became a "contractor" there. This was the beginning of what was to become one of the most mechanically fertile business friendships ever recorded.

As the years passed and each grew to know and respect the ability of the other—Pratt for design and Whitney for production—it was almost inevitable that they should have reached the decision to pool their resources and work out their own destiny. So in a little room on Potter St., fitted with only a few tools and a stove, they began their association in business. Here they spent all their spare time from their regular jobs, doing work on their own account. One of their first accomplishments—building Spencer's Automatic Silk Winders for the Cheney Silk Mills—brought them much more work and the beginning of a good name, which enlarged and brightened with larger and more difficult tasks, well done, through succeeding years.

A fire and the Civil War with its attendant needs for firearms, gave the two men a new and larger place of business in a building at the rear of the old Hartford Times office. They took in a partner—Monroe Stannard of New Britain—with $1,200 of his capital, in 1862, and with $2,400 of their own savings, continued to expand. Stannard operated the business while Pratt & Whitney continued to hold their jobs until 1865, when the rush of business made it necessary to expand again. They decided to build a three story building on the present site of their plant. When the plant was completed in March, 1866, the two men resigned their positions at the Phoenix Iron Works and began to throw their full-time energies into their budding enterprise. In 1869 the company was formally incorporated with a capitalization of $300,000 which was increased largely through earnings to $500,000 by 1875.

After the Franco-Prussian War in 1870, an agent of Pratt & Whitney Co. visited the Imperial and private gun factories of Germany and discovered that very antiquated machinery was being used. He then interested a Berlin engineer sufficiently in Pratt & Whitney equipment to send for Mr. Pratt. The net result of Mr. Pratt's visit was $350,000 worth of orders from the German government. Six more trips in 3 years netted orders for equipment and machinery in the amount of $1,250,000—an extraordinary amount of business at that time from one source in so short a period. The quality of the machines, their erection and the instruction of German operators was so well done that it evinced a laudatory letter from the German government—another occurrence contrary to precedent.

Because of the lack of a standard inch in 1860, the interchangeable parts system was not as refined as Amos Whitney desired. He insisted that if mass production was to be attained for the benefit of the masses, it could only come about through the mechanical production of millions of parts, held to exact dimensions by more accurate gauges than available at the time. A Gauge Division of the company was formed and after several years of painstaking research, a correct inch was arrived at by means of a machine, known as the Rogers Bond Comparator, which would make end measure comparisons correctly down to one fifty-thousandth of an inch. When Professor William A. Rogers, Professor of Astronomy at Harvard College and George M. Bond, a graduate of Stevens Institute of Technology, began their experimental work which resulted in the comparator, the tools used for measurements in different shops varied widely in dimension. Through Professor Rogers' efforts in London and Paris and with the United States Coast Survey, several accurate bar copies of the British, French and United States yard were made, thus giving the Pratt & Whitney Co. the highest rank as an authority on accuracy. The results of the research, combined with the Rogers Bond Comparator, brought about the development of the Pratt & Whitney Standard Measuring Machine, accurate to one hundred-thousandth of an inch. Completed in 1885, it is known throughout the world today as the basis for the construction and duplication of recognized standards of length.

Products of the Pratt & Whitney Co. up to 1900 were widely varied showing no apparent attempt at specialization. Among the products made up to that time were various types of lathes, boring mills, shapers, planers, vertical drills, multiple drills, grinders, screw machines, tapping machines, milling machines, cam making machines, die sinkers, profilers, various power presses, power hammers, gun machines, a crane, a reciprocating hydraulic engine, a variety of bolt cutters, taps, drills, dies, wrenches, plain and thread gauges, combination lathe chucks, iron moulders, flasks, and many other items too numerous to mention. Automatic weighing machines for grain and coal were also made about 1890, the company apparently being one of the pioneers in this field which now occupies the undivided attention of several concerns.

The company's reputation for accuracy together with its early gun making activities brought it many models of guns to be developed under the supervision of inventors. Among these was the Lee gun, the Mauser, the Sponsel, the deKnight and the Hotchkiss. Also numerous other first models of products were developed there including typewriters, envelope machinery, the first noiseless typewriter, the Hollerith tabulating machine and the original model of the Paige typesetter which proved too expensive to built but which formed the basis for the Mergenthaler and other typesetting machines of the day.

In 1901, when the company became one of the four plants of the Niles-Bement-Pond Company, the plant was thoroughly reorganized with a view of more specialization on machine tools, gauges and small tools and production on a quantity basis. The manufacture of machinery and equipment for government arsenals has continued to bulk large. Included among the important orders received was one from the Japanese government, one from the

Australian government and numerous orders from the United States War Department. More than a dozen other governments have also been served. Another notable gauge development just after the war was the perfection of the Hoke gage blocks which originated from Major Hoke's laboratory system of precision lapping. The blocks produced could be guaranteed permanently accurate within five millionths of an inch for blocks up to six tenths of an inch and with similar guarantees in proportion for larger sizes.

During the slow period from 1920 to 1925, Pratt & Whitney re-designed its products, modernized shop arrangement and delved into the mysteries of new metals applying in peace time the knowledge learned in the World War.

Thus from the original efforts of two men in a small room in 1860, working spare time with a few hundred dollars as capital, has grown up in 75 years an institution that employs over 2000 men in normal times, a $3,000,000 capital, occupies nearly a million square feet of floor space, has offices in all principal cities of the United States and representatives throughout the world. Accuracy as the kite-tail guiding the great ambitions of Francis Pratt and Amos Whitney to greater accomplishments, sent the company on its way to a successful maturity; continuation of these standards through progressive research with manpower, grounded in the ideals of the founders, has continued to identify the company as a leader in the machine tool field during its journey through the 20th century.

The Pratt & Whitney product of today is outstanding in design, accuracy and quality, and is used in nearly all industrial establishments in this country and in many others throughout the world, particularly in Europe, for the manufacture of accurate parts.

Pratt & Whitney Model B Lathes are recognized as the "last word" in precision. Another machine, the Jig Borer, made in several sizes, was designed and developed for accurately locating and boring holes, and has proved to be a good investment in every plant where one has been installed.

Other lines of product include complete tool room equipment, Vertical Shapers, Bench Lathes, Bench Milling Machines, Grinding Machines, Measuring Machines, Machines for accurately grinding the teeth of spur and helical gears, Thread Milling Machines, etc.

Of great importance also is the development of die sinking machinery, and in addition to several sizes of Plain and Universal Die Sinkers, are the Pratt & Whitnew Keller Automatic, electrically controlled Die Cutting Machines, formerly manufactured by the Keller Mechanical Engineering Corp. of Brooklyn, N. Y. This company was acquired and moved to Hartford in the fall of 1931. The Pratt & Whitney Keller machines are particularly adapted for the manufacture of dies used in connection with the production of automobile parts, such as fenders, bodies and other miscellaneous stampings, and has been an important factor in lowering the prices of today's stream-lined autos.

Pratt & Whitney products also include a complete line of small tools, milling cutters, taps, reamers, dies, drills, hobs, etc., and in addition the increasing demand for its precision gages, John-Sons Roll Thread Gages, Electrolimit Gages, A. P. I. Gages, A. R. A. Gages, and many special types, has resulted in materially increasing the manufacturing facilities for this important line.

The story of Pratt & Whitney would not be complete without mention of some of the prominent mechanics who received their training there and who went to the Middle West and New England points to become prominent in the machine tool or allied fields. They were Worcester R. Warner and Ambrose Swasey who started Warner and Swasey of Cleveland, O.; E. C. Henn and R. Hakewessel of the National Acme Mfg. Co., who developed the multi-spindle automatic lathe; A. F. Foote of Foote, Burt & Co.; George C. Bardons of Bardons and Oliver; John Johnston of Potter & Johnston, Pawtucket; J. N. Lapointe, developer of the broaching machine; F. N. Gardner of Beloit, Wis., inventor of the Gardner grinder; Gleason, founder of the Gleason Works; E. P. Bullard, founder of the Bullard Co. of Bridgeport; and a number of others. The apprentice training system which for years had 40 to 50 young men in training was discontinued temporarily around 1930.

Present officials of the company are: Clayton R. Burt, President; C. M. Pond, Vice President and Manager of the Small Tool & Gage Division; W. P. Kirk, Vice President in Charge of Sales; E. L. Morgan, Secretary, and C. K. Seymour, Treasurer.

The Bullard Co.

E. P. Bullard, mentioned earlier in our story as being a workman in both Colt's Armory and Pratt & Whitney Co., at Hartford, left the employ of the latter company in 1864, to start his first business venture, a partnership known as Bullard & Prest, General Machinists, of Hartford. Born in Uxbridge, Mass., in 1841, Mr. Bullard had started as an apprentice with the Whitinsville Machine Works at Whitinsville, Mass., when only a lad of 17. On becoming a journeyman he came to Hartford to work at Colt's Armory. In 1863 he left Colt's to enter the employ of Pratt & Whitney, where he stayed approximately one year before opening his shop in the Old Hartford Jail building. This business was continued in Hartford under three different partnership names until 1868, then was moved to Bristol only to be dissolved the next year.

Mr. Bullard next went south to become superintendent of a large machine shop in Athens, Ga., but shortly resigned on account of the bitterness of southern workmen toward northerners. Going directly to Cincinnati he started a second hand machinery business, but soon gave up that venture to become affiliated with Post & Co. as organizer of its machine tool department.

The years 1872 and 1873, Mr. Bullard spent as superintendent of the Gill Car Works in Columbus, O., and of the Cooper Engine Works at Mt. Vernon, O. The next year he established his own business on Beekman St., New York, and in 1875, organized the machinery firm of Allis-Bullard & Co. This business was continued at the same address until 1880 when Mr. Bullard secured control.

By 1882, when there seemed to be a demand for a high grade lathe, Mr. Bullard made an arrangement with A. D. Laws, of Bridgeport, to manufacture heavy metal lathes of Bullard design, the lathes to be taken by Mr. Laws. When the arrangement proved to be unsatisfactory, Mr. Bullard took over the business July 1, 1882, naming it Bridgeport Machine Tool Works. During the first year of operation of the new business, he designed his first vertical boring and turning mill, which is believed to be the smallest machine of its kind having such a small capacity (boring and turning work 37 inches in size which had been previously done on other types

of lathes). Seven years after the business was started, Mr. Bullard discontinued his New York connections, devoting his entire time to the development of the Bridgeport plant.

In 1894 the company was incorporated as The Bullard Machine Tool Co. with the stock of the company being held by E. P. Bullard and his sons Dudley, Payson and Stanley and his nephew Augustus. A short time later two other sons were included as members of the firm. Originally occupying one floor on the corner of Broad Street and Railroad Avenue, the company gradually expanded until it utilized several buildings which occupied almost the entire block.

The next factory expansion took place in 1915 when a new five story concrete plant was built on the site of the original location. Even this large plant was not sufficiently large, for the Government erected a large plant on the Bullard property in Black Rock, in 1917, to enable the Bullard Engineering Co., organized to handle special government work, to have space to work with the Watervliet Arsenal on a joint order for 2160 cannons of the 155 M. M. class, for high velocity. Eight cannons per day were produced at the plant. At the close of the war, special equipment of the Gun plant was disposed of and the buildings auctioned by the Government. The Bullard Machine Tool Co. purchased the property, dissolved the Engineering Works and shortly afterward removed all equipment from the Broad Street plant to Black Rock. Shortly after this move business fell off severely, the real post war depression lasting from the fall of 1920 to autumn of 1922, bringing with it a severe financial strain. The second generation of Bullard's managed to weather the storm without any real casualty, emerging from it much wiser and more firmly established.

The period from 1922 to 1930 was characterized by a prosperous growth including the erection of a model office building in 1929, the year the name of the company was changed from The Bullard Machine Tool Co. to the Bullard Co. From its first modest start in Bridgeport, the company has built lathes of the horizontal type, but since 1913 when the multiple spindle machine, known as the Mult-Au-Matic was introduced, it has dominated all other company products in terms of customer demand.

The Mult-Au-Matic is a vertical tool carrying heads affixed to moveable slides placed around a central column. As work operations are completed at each station, the slides move from the work to a vertical position. The carrier which holds the spindles then indexes to the next station. The operator at the loading station removes one piece of finished work and replaces it with one piece of rough work. This complete machining cycle of rough to finished product in the time of the longest operation is called the Mult-Au-Matic method. The method applies today to mass production of a wide variety of products just as it did in 1913, but many improvements have been made in machine design as well as additional automatic features. The Mult-Au-Matics are made in a wide range of sizes to suit practically all high speed production needs. Their wide usage in automobile and automobile accessory plants as key production units are typical examples of their qualifications for high speed work.

Another of the company's outstanding products is the vertical turret lathe. Still others are known as Vertical Automatic Lathes and Contin-U-Matics. Bullard machines are used in practically all branches of industry building products out of metal.

The company normally employs 1300 people and sells its products through branch offices and sales representatives in the U. S. and several foreign countries. Within its present fold are seven of the third generation of the Bullard family continuing the high standards of the engineering and craftsmanship started by its founder.

Present officers of the company are: Edward P. Bullard, president; Edward C. Bullard, vice president and general manager; John W. Bray, vice president, sales and export manager; D. B. Bullard, vice president and mechanical engineer; and Arthur E. North, secretary and treasurer.

The Hendey Machine Co.

Henry J. Hendey, a young English-born journeyman toolmaker of Wolcottville, Conn., had a lot of ambition, little money and no job, back in 1870, when he determined to start a machine business with his brother Arthur Hendey, of New Haven. The brothers first rented space in the machine shop of Turner, Seymour and Judd Company of Wolcottville, now Torrington. At first Henry Hendey worked only at night in his own shop, since he had been offered his old 12 hour per day job just prior to opening the new workshop. The following spring, with the few dollars the two brothers could get together, Arthur Hendey built a small one story shop on land belonging to his father, which was the first proprietary works of Hendey Brothers. It is still preserved today in a remodeled state as a dwelling on New Litchfield Street, Torrington.

The first business received in the tiny shop was in the form of small job orders and the earliest attempt to make machinery was the acceptance of a contract to manufacture about 20 wood turning lathes. A satisfactory conclusion of this work brought orders for manufacturing machinery for grooving, punching and swaging. Machines were also made for producting shoe nails, kerosene lamp burners, clock parts, slitting brass, straightening and pointing fine wire and hand power jig saws. Side lines included the production of steam gauges, glass cutters and other miscellaneous small articles.

In 1887, a line of plain screw cutting engine lathes were dey on account of ill health, the concern was organized as a stock company under its present name and began the manufacture of its first engine lathe, a 4½″ swing, 15″ centers, screw cutting machine, which was followed by a lot of 8″ swing lathes with 4′ beds. The following year the company secured patent rights to manufacture the Manville patent friction driven iron working shapers and planers, both types being displayed at the Philadelphia Exposition in 1876. Concurrently with the manufacture of shapers and planers, The Hendey Company made a variety of hand lathes, sensitive and multiple spindle drills, hand chucking or capstan lathes as well as some production machinery for handling agricultural mowing machine frames, bicycle hubs and a few other miscellaneous types of production machines.

In 1887, a line of plain screw cutting engine lathes were placed on the market, continuing to be sold until 1892, when a contract was made with W. P. Norton to produce his Improved Quick Change Gear Screw Cutting Engine Lathe, which was immediately recognized as a big advance in engine lathe efficiency. For a number of years afterwards a large part of the production of this lathe was shipped abroad to representative shops in both Great Britain and the continent of Europe. In the same

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PRATT & WHITNEY CO.
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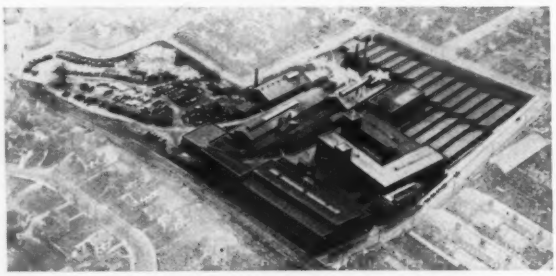
Machine Tools, Small Tools, Gages, Keller Machines and Special Machines

year that the Hendey Company started production of the Norton Lathe it also completed what is believed to be the first portable motor driven shapers; also traverse shapers and the popular Hendey 15" friction clutch driven pillar shaper.

The year 1900 marks the entrance of The Hendey Machine Company into the field of milling machine manufacture, for in that year it received an order to produce for the Rock Island Arsenal 240 Lincoln type milling machines. At about the same time this company added to its products a line of knee type milling machines.

About 1915 the company started the manufacture of crank driven shapers which added considerably to the company's prestige as machine tool builders. Bridging the span of years from 1915 to 1933 with many engineering improvements to its present products, the company launched its newest and in many respects its most remarkable shaper, known as the Hendey 12" High Speed Shaper, which combined in a remarkable degree, lightness, speed, power and ease in handling. Another special lathe developed in recent years is the Hendey High Speed Precision Turning Lathe which has been found exceptionally efficient in turning needle valves and similar parts requiring precision taper fit without the necessity of grinding.

At the present time the Hendey Geared Head 12-speed quick change gear engine lathes form the main product of the company. This product, probably more than any other, is responsible for the high position occupied by the Hendey Company in the field of lathe builders. Hendey's reputation like those of all other companies, is due primarily to the quality of its leadership, among which are included the following notable past presidents: A. F.



The Factories of The Hendey Machine Company Torrington, Conn.

Where

HENDEY

Precision Lathes and Shapers are manufactured

1874 - *Sixty-one Years* - 1935

Migeon, one time head of the Union Hardware Company; Charles F. Brooker, founder and first president of the American Brass Company; Charles F. Church, active in Waterbury circles; Henry J. Hendey, founder of the company; F. F. Fuessenich with the company since its early days; Charles H. Alvord, who shaped the destiny of the company in the World War; and John A. Coe, president of the American Brass Company.

Engineers responsible for the development of the company's products were E. J. Manville who designed the friction shapers, W. P. Norton, C. Bouillon, and G. H. Knight.

The Hendey Machine Company in normal times employs approximately 800 persons and distributes its products through direct representation from the home office and branches in New York, Boston, Rochester, Chicago and Detroit. In addition agency representation has also been established in numerous other cities of the United States as well as in Canada, Great Britain and several of the other industrial countries of Europe.

Present officials of the company are: David Ayr, president; F. N. McKenzie, secretary and W. A. Reynolds, assistant treasurer and vice president.

The Henry & Wright Manufacturing Co.

The present Henry and Wright Manufacturing Company, of Hartford, is the outgrowth of a corporation originally formed in March, 1903, to continue the business previously conducted as a partnership by Robert G. Henry and Daniel M. Wright, both of whom were formerly connected with the American Specialties Company. Mr. Henry was a die maker with this company while Mr. Wright was a bookkeeper.

The early product of the company was a single line of pedestal type drilling machines which, through extensive experimental and development work, was rapidly expanded through the years. Henry and Wright now produces a complete line of sensitive high speed ball-bearing drilling machines, ranging from the bench type machines of ¼" capacity to multiple spindle pedestal type high speed drilling machine of 1⅛" capacity. Along with this line of drilling machines has been developed a complete line of attachments, including oil systems and automatic power feeds. Because of the success of its drilling machines and attachments the company has long been recognized as among the leaders in this field of manufacture.

In 1918, the Henry and Wright Manufacturing Company produced its dieing machine, a patented new type automatic power press invented by Daniel M. Wright which, after considerable development, is now produced in a variety of capacities ranging from 10 to 150 tons. The larger machines are made in both single and double crank types. The company also produces a complete line of automatic roll feed attachments for each size of press as well as automatic scrap cutters for each type of dieing machine. The dieing machines, which are now the company's leading products, have become internationally known because of the results obtainable with them in the automatic production of intricate stampings, produced complete at each stroke of the machine.

For the past several years, conventional type presses of welded steel construction, incorporating patented features developed by the company, have been manufactured, as well as the automatic roll feed and scrap cutter attachments. The Henry and Wright Manufacturing Company is believed to be among the first to use welded steel construction in the manufacture of punch presses and was the originator of the tie rod type straight sided steel press. By this method of construction the company was able to offer not only machines of standard specifications, but also to readily make adaptations to meet the demands of punch press users who required special types.

In the miscellaneous field of production, the company manufactures a line of stock and scrap reels for handling coil stock, which includes not only the conventional type reel, but also a number of sizes of motor driven automatically controlled reels.

The present officials of the company are: President, F. K. Simmons; vice president and secretary, D. C. Jewett; treasurer, H. H. Hilliard.

Individual histories of the remaining Connecticut machine tool manufacturers, together with some illustrations of their products, will appear in the June issue as follows: The Automatic Machine Company, The Producto Machine Company, The Baird Machine Company, The American Chain Company, Curtis and Curtis, The Bodine Corporation, The Grant Manufacturing Company, Bridgeport Safety Emery Wheel Company—all of Bridgeport; The Rowbottom Machine Company of Waterbury; The Geometric Tool Company of New Haven, The Taylor and Fenn Company and The Hanson and Whitney Company of Hartford; The New Britain-Gridley Machine Company and Goss DeLeeuw Company of New Britain.

LEGISLATION

(Continued from page 2)

Workmen's Compensation. All bills heard April 2 were reported unfavorably the following day except H. B. 816—increasing indemnity for loss of eye from 156 weeks to 312 weeks, which has considerable support. Chances are about 50-50 on tabling or passage.

H. B. 1039—Held as an omnibus bill in committee to which other provisions desired by Connecticut Federation of Labor may be added. (See Page 19, C. I. for April giving brief outline of bill.)

H. B. 773—Creating competitive state insurance fund being held in committee. Has some backing but chances of passage appear slight.

Labor. The hours of labor bills are still being held by the Labor committee, allegedly waiting for action by Congress before reaching a decision on limitation of hours of labor for men and women in the state. About 50% of the remaining bills referred to the Labor committee have been rejected by either the House or Senate or both, after unfavorable reports.

Taxation Bills. The majority of tax bills are still in committee including all of Special Tax Commission bills. Sales tax is expected to be reported out favorably before the ink is dry on this summary.

SERVICE SECTION

On account of space limitations, the material and used equipment items offered for sale by Association members have not been classified by sizes or usage best adapted. Full information will be given on receipt of inquiry. Listing service free to member concerns.

●● Materials for Sale

COLD rolled steel in coils and in squares, condulets and fittings, remnants of covering materials—velours, velvets, mohair, tapestries, denims, chintzes, and cretonnes, semi-finished and castellated U. S. S. nuts, pulleys, flat and crown face-steel and cast-iron; new shaft hangers, brass wire, brass rods, aluminum tubing, cold drawn steel—mostly hex; miscellaneous lot of material used in the manufacture of molded rubber parts and flooring, knife switches—new and many sizes; carload C. I. drop bases; lead pipe, lead sheet, acid proof pipe fittings, 124 bars screw stock varying thicknesses and lengths, white absorbent tissue process from cotton, rotary convertor, colors and dyes—large variety, lacquers—several hundred gallons in assorted colors; and soft anneal copper with high silver content in rolls. J. H. Williams wrenches in assorted sizes.

●● Equipment for Sale

ACCUMULATORS, annunciators, baskets, beaders, beamers, bearings, belt stretchers, blowers, boilers, braiders, bronze runners, cans, cards, woolen; car loaders, chain, chairs, chamfer, clocks, time recorders; clock systems, colors and dyes, compressors, condulets, convertors, conveyors, cookers, cooking utensils, doublers, draftsman's table, drop hammers, drops, board; drums, drying racks, dyes, engines, evaporators, extractors or percolators, fans, filtering carbon, folders, forming rolls, frames, furnaces, gears, generators, grinders, grindstones, grinding wheels, guiders, headers, lamp shades, lathes, lifters, looms, De Laski circular; machines, automatic; machines, calculating; machines, compressing; machines, dieing; machines, drilling; machines, filing; machines, filling; machines, folding; machines, knitting; machines, mercerizing; machines, milling; machines, pipe-cutting and threading; machines, pleating down; machines, riveting; machines, screw; machines, threading; machines, tongue and groove; machines, washing; mercerizer equipment; millers, mixers, mills, mills rubber; mixing rolls, motors, oil circuits; oven drawers, paints and lacquers; panels, planers, plungers, pointers, presses, profilers, pulley drives, pumps, reamers, receivers, rheostats, safe cabinets, saws, scales, screens, seamers, shapers, shears, spindles, spinning mules, steam tables, steam warmers, stitcher, 192 monitor corner box switches, tables, tanks, toilet equipment, trucks, ash can; tube closers; wire, wire screw and yarders.

●● For Sale or Rent

FOR SALE. One 3½ Bliss toggle press in good condition. Address S. E. 76.

FOR SALE. 1 Bigelow H. R. T. boiler. 53 B. H. P. Will pass inspection. With fittings. Address S. E. 79.

FOR SALE—Free Cutting Bessemer Screw Stock of various sizes ranging from 7/16" to 5" in Rounds: 1⅛" to 1½" in Squares; and ⅞" to 2" in Hexagons. Also Cold Rolled Steel ½" x ⅛" to 3½" x ¼". Address S. E. 80.

FOR SALE. One N. C. Grindstone 72" diameter x 12" face, brand new and offered for sale at reasonable price by company which has discontinued use of grindstones. Address S. E. 86.

●● Wanted to Buy

WANTED. USED—1 Portable Recording Wattmeter, 3 Phase, 3 Wire, 60 Cycles, 230 and 575 Volts, 5 Amperes, Synchronous Motor Drive (1" per hour and 1" per minute suggested); 2 Current Transformers for above, 20-25-40-50-800-1,000 Ampere Rating; 1 600-KVA, 440 Volt, 3 Phase, 600 RPM Alternating Current Generator, with Exciter; Exciter preferably directly connected to Generator. Generator must have amortisseur windings. Address S. E. 87.

WANTED—MANUFACTURER OF SHEET METAL PRODUCTS, who desires to consolidate his business with another growing concern which now sells its own sheet metal products to chain stores and mail order houses. If interested in talking over consolidation address a letter to S. E. 88.

●● Employment

AGENTS AND DISTRIBUTORS. Vitelli & Cia., Peru 84, Buenos Aires, Argentina, are interested in acting as agents and distributors for a manufacturer of hardware, shovels, etc. For further particulars write to The Argentine Chamber of Commerce, 245 Broadway, New York City.

ACCOUNTANT. Experienced in general accounting and cost work. Would like experience with auditing firm as junior or semi-senior. Age 32 and married. Salary requirements moderate. Address P. W. 275.

SALES MANAGER OR SALESMAN. Engineer with wide experience and contacts with manufacturing executives both in New England and throughout the country, desires position where his many contacts will be of greatest benefit. Primarily his experience has been in the promotion of steel sales, but it would be most valuable in the sales of equipment, tools or other items used by manufacturers. He will consider any location at any reasonable salary. Address P. W. 280.

POSITION WANTED. Chemical Engineer, Tufts 1934, desires connection with firm in chemical, engineering or sales capacity. No practical experience. Past seven months spent in foreign travel. Very nominal salary accepted at start. Address P. W. 285.

PRODUCTION MANAGER. Trained by and worked on personal staff of H. L. Gantt. Experienced in production control, budgeting and control of inventories to effect turnover, and coordination of plant production with sales budgets. Have installed standard costs. Understand, but have not specialized on rate setting. Experience mostly in textiles but fundamentally fitted for any industry. Address P. W. 287.

OFFICE MANAGER, PAYMASTER OR EMPLOYMENT MANAGER. Married man with good business training and over 20 years' experience in various types of office work with manufacturing establishments, railroads and state commissions, finds it necessary to seek new connections because of closing out the business of last employer. His experience covers such positions as cashier and correspondence, paymaster, employment manager, supervisor of stock records department, office manager and purchasing agent. In the prime of life, this man is in a position to give intelligent, conscientious service for reasonable returns for the next 20 to 25 years. For reference or interview appointment address P. W. 290.

CHEMICAL ENGINEER. Young man, graduate of Wesleyan and Yale Universities with B. S., M. S. and Doctor's degree in chemistry, who has been employed for 2½ years as a Development and Research Chemical Engineer, now seeks a new opportunity because of the curtailment of research activity by his present employer. Employer speaks in high praise of his ability, personality and habits. Companies planning to expand their research or laboratory work would do well to write for further details and appointment. Address P. W. 291.

JUNIOR ACCOUNTANT. Young High School graduate who has completed a nine months' course in accounting at a reputable business college where training included cost accounting and payroll auditing, is earnestly seeking a position in the accounting department of an industrial or commercial establishment, public accounting firm or for the time being will accept any clerical opportunity. For further details address P. W. 292.

SUPERINTENDENT, PRODUCTION MANAGER OR FOREMAN. Married man who has advanced himself from a clerk to various production positions to become superintendent in a large metal working plant, seeks any type of a production position in Connecticut or New England concern where there is a reasonable opportunity for advancement in regular employment. Has had experience in foundry work, both brass and iron, plating, finishing, lacquering, buffing, polishing, rolling, machining, press work, assembling and numerous other productive operations. For further particulars and interview address P. W. 293.

MACHINE DESIGNER, who has completed design for fruit press, embodying entirely new principle wishes to interest manufacturer in building press. Very small investment required. Address P. W. 294.

ANOTHER CONNECTICUT INDUSTRY TESTIFIES:

The Charles Parker Company

(Meriden)

IN TEN YEARS SHOWS A

CLEAR GAIN OF $669.18

ON WORKMEN'S COMPENSATION INSURANCE PLACED WITH AMERICAN MUTUAL

PARKER PRODUCTS include: Parker Vises; Parker-Hawes Fishing Rods; Parker Bathroom Accessories, Refrigerator and Builders' Hardware; Piano Benches; Cremation Urns; Coffee Mills; Gray Iron Castings; and Wood Screws.

While the savings mentioned above cover only the last decade, this estimable Connecticut concern started using American Mutual service in 1914. In all the intervening twenty years—in fact, since its very organization, in 1887—the American Mutual has never failed to return to its policyholders annual savings, in the form of dividends, of 20% or more of the initial premiums paid in.

Traditional New England conservatism in selecting risks and truly economical management have helped to make this extraordinary record possible. But of at least equal importance, perhaps, has been this Company's highly organized safety engineering department. By helping policyholders to prevent accidents, this invaluable service quite naturally helps to reduce their production costs.

And—since the American is a *mutual* company, and does not operate mainly for the benefit of a lot of stockholders, it is able to share to the utmost its profits or savings with its policyholders. Is not the opportunity to become a participant in such savings worth your consideration in behalf of your concern?

Why not let us study your liability insurance problems? You place yourself under no obligation in asking our nearest branch office to send some one to see you. Fifty-two branch offices, manned and supported by a competent staff of claim managers, adjusters, engineers and medical advisers are ever at the service of American Mutual policyholders — of whom *96% renew their insurance with us regularly year after year.*

AMERICAN MUTUAL

LIABILITY INSURANCE COMPANY

WORKMEN'S COMPENSATION AND AUTOMOBILE INSURANCE

As filed with the Connecticut Insurance Department, as of December 31, 1934

Assets: $19,398,816.08 Liabilities: $15,534,741.28 Surplus to Policyholders: $3,864,074.80

Executive Offices: BOSTON, MASS., 142 Berkeley Street

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AMERICAN-HAWAIIAN'S

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CAREFUL HANDLING
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